Journal of the Royal Society of Arts

NO. 5029 DECEMBER 1958 VOL. CVII

TWO HUNDRED AND FIFTH SESSION 1958–59

PATRON: HER MAJESTY THE QUEEN

COUNCIL

HIS ROYAL HIGHNESS THE PRINCE PHILIP, DUKE OF EDINBURGH, K.G., K.T., President
SIR ALFRED BOSSOM, Bt., LL.D., F.R.I.B.A., J.P., M.P., Chairman of the Council

VICE-PRESIDENTS

SIR EDWARD CROWE, K.C.M.G.
SIR GEORGE EDWARDS, C.B.E.
SIR ERNEST GOODALE, C.B.E., M.C.
ROBERT W. HOLLAND, O.B.E., M.A., M.SC., LL.D.
SIR HARRY LINDSAY, K.C.I.E., C.B.E.
THE EARL OF RADNOR, K.C.V.O.
E. MUNRO RUNTZ, F.R.I.C.S.
COLONEL WALTER J. BROWN, V.D., LL.D., J.P. (Hon. Corresponding Member for Canada)
PROFESSOR R. D. RUSSELL (Master of the Faculty of Royal Designers for Industry)

ORDINARY MEMBERS OF COUNCIL

MRS. MARY ADAMS, O.B.E., M.SC.
W. GREENHOUSE ALLT, MUS.D., F.R.C.O., F.T.C.L.
SIR HILARY BLOOD, G.B.E., K.C.M.G., LL.D., M.A.
THE HONBLE. G. C. H. CHUBB
R. E. DANGERFIELD
ROBIN DARWIN, C.B.E.
F. A. LE NEVE FOSTER, HON.F.S.I.A.
E MAXWELL FRY, C.B.E., B.ARCH., F.R.I.B.A.
JOHN GLOAG, HON.A.R.I.B.A.
THE EARL OF HALSBURY, F.R.I.C., F.INST.P.
A. C. HARTLEY, C.B.E., B.SC., F.C.G.I., M.I.C.E., M.I.MECH.E.
LORD LATHAM, J.P., F.A.C.C.A., F.C.I.S.
EDGAR E. LAWLEY
OSWALD P. MILNE, J.P., F.R.I.B.A.
LORD NATHAN, P.C., T.D., D.L., J.P., F.S.A.
SIR GILBERT RENNIE, G.B.E., K.C.M.G., M.C.
A. R. N. ROBERTS
SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C., M.D., F.R.C.P.
SIR PHILIP SOUTHWELL, C.B.E., M.C.
PROFESSOR S. TOLANSKY, PH.D., D.SC., F.R.S.
HUGH A. WARREN, N.SC.(ENG.), M.I.C.E., M.I.STRUCT.E.
SIR GRIFFITH WILLIAMS, K.B.E., C.B.
MISS ANNA ZINKEISEN, R.O.I., R.D.I.

TREASURERS

F. A. MERCER, HON.F.S.I.A.
G. E. TONGE

SECRETARY

K. W. LUCKHURST, M.A., PH.D.

Deputy Secretary: G. E. MERCER, B.A.
Assistant Secretary: J. S. SKIDMORE
Examinations Officer: F. A. WHEELER Assistant Examinations Officer: J. H. FLANDERS
Examinations Adviser: J. P. IVENS, M.A., B.COM.
Accountant: I. PURDAM, A.C.A. Curator-Librarian: D. G. C. ALLAN, M.SC.(ECON.), F.R.HIST.S.
Registrar: J. SAMSON, A.C.I.S.
Honorary Solicitors: MESSRS. BRISTOWE, COOKE & CARPMAEL
Auditors: MESSRS. DELOITTE, PLENDER, GRIFFITHS & CO.

A list of Standing Committees for 1958–59 is published on pages 65-69 of this issue.

PRESENTATION OF THE ALBERT MEDAL TO H.M. THE QUEEN

The Queen received the Albert Medal for 1958 from the Duke of Edinburgh, President of the Society, at Buckingham Palace on Thursday, 6th November. As announced in the June issue of the *Journal*, the medal was awarded 'to mark Her Majesty's personal service to arts, manufactures and commerce, at home and abroad'.

In presenting the medal to Her Majesty, the Duke of Edinburgh recalled that, as President of the Society before acceding to the throne, she herself had on several occasions made the presentation of the Albert Medal to others. The Queen, in her reply, expressed her great pleasure in the award, and spoke of the day in 1951—the exact centenary of the opening of the Great Exhibition—when, at the Society's House, she announced that King George VI had accepted the award of the medal for that year.

The following present and former Members of Council had the honour of being received by the Queen on this occasion: Sir Alfred Bossom (Chairman); Mrs. Mary Adams; Dr. W. Greenhouse Allt; Sir Edward Crowe; Mr. R. E. Dangerfield; Mr. Robin Darwin; Sir George Edwards; Mr. Peter Le Neve Foster; the Earl of Halsbury; Mr. A. C. Hartley; Dr. R. W. Holland; Mr. William Johnstone; Lord Latham; Mr. E. E. Lawley; Sir Harry Lindsay; Mr. F. A. Mercer; the Earl of Radnor; Sir Gilbert Rennie; Mr. A. R. N. Roberts; Professor R. D. Russell; Sir Harold Saunders; Sir Selwyn Selwyn-Clarke; Dr. L. Dudley Stamp; Professor S. Tolansky; Mr. G. E. Tonge; Mr. H. A. Warren; Sir Griffith Williams and Miss Anna Zinkeisen; with Dr. K. W. Luckhurst (Secretary) and Mr. G. E. Mercer (Deputy Secretary).

VISIT OF H.R.H. THE PRESIDENT

His Royal Highness the Duke of Edinburgh, with Mr. James Orr in attendance, visited the Society's House on 11th November and, after inspecting the new premises, took luncheon with the Chairman and members of Council.

In the course of his tour of inspection, the President saw the Committee Room, the two Exhibition Rooms, the Council Chamber and the new Fellows' Rooms—all of them recently decorated and furnished. Senior members of the Society's staff had the honour of being presented to His Royal Highness.

His Royal Highness signing the Visitors' Book in the Secretary's office, watched by the Chairman of Council (right) and Dr. Luckhurst

The following members of Council attended the luncheon: Sir Alfred Bossom (Chairman); Mrs. Mary Adams; Dr. W. Greenhouse Allt; Sir Hilary Blood; Sir Edward Crowe; Mr. R. E. Dangerfield; Mr. Robin Darwin; Sir George Edwards; Mr. Peter Le Neve Foster; the Earl of Halsbury; Mr. A. C. Hartley; Dr. R. W. Holland; Lord Latham; Mr. Edgar E. Lawley; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. O. P. Milne; the Earl of Radnor; Sir Gilbert Rennie; Mr. A. R. N. Roberts; Professor R. D. Russell; Sir Selwyn Selwyn-Clarke; Professor S. Tolansky; Mr. G. E. Tonge; Mr. Hugh A. Warren; Sir Griffith Williams and Miss Anna Zinkeisen. Dr. K. W. Luckhurst (Secretary) and Mr. G. E. Mercer (Deputy Secretary) were also present.

In a short speech after luncheon, the Duke of Edinburgh emphasized the pressing need to bring up-to-date knowledge of scientific and industrial achievement and development to the notice of the younger men in industry and business —the 'managers of tomorrow'. He spoke also of a criterion by which British performance in these fields could be judged, and expressed the view that this Society could help in providing the basis for such a judgment by publicizing (through lectures and exhibitions) not only the achievements of British industry and commerce but also significant comparable developments taking place in the U.S.A. and on the Continent.

The luncheon given to the President in the new Council Room. His Royal Highness is seen (fourth from the right) in conversation with the Chairman of Council. Others readily discernible in the photograph are (reading from the extreme right) Sir Edward Crowe, Dr. R. W. Holland and—on the President's left—the Earl of Radnor

FORTHCOMING MEETINGS

WEDNESDAY, 3RD DECEMBER, at 2.30 p.m. '*The Consulting Engineer and His Contribution to the National Economy*', by Julian S. Tritton, M.I.C.E., M.I.Mech.E., President, International Federation of Consulting Engineers. J. K. Vaughan-Morgan, M.P., Minister of State, Board of Trade, in the Chair.

MONDAY, 8TH DECEMBER, at 6 p.m. The last of three CANTOR LECTURES on '*The Aeroplane*': '*The Future of the Aeroplane*', by Eric Mensforth, C.B.E., M.A., M.I.Mech.E., F.R.Ae.S., Chairman, Westland Aircraft Ltd.

WEDNESDAY, 10TH DECEMBER, at 2.30 p.m. '*Large Scale Organization and Change: a Study in oil Marketing*', by Christopher T. Brunner, a Director of Shell-Mex and B.P. Ltd. Sir Arnold Plant, Sir Ernest Cassel Professor of Commerce, University of London, in the Chair. (The Paper will be illustrated.)

TUESDAY, 16TH DECEMBER, at 5.15 p.m. COMMONWEALTH SECTION. '*Land Utilization in the Commonwealth*', by L. Dudley Stamp, C.B.E., D.Lit., D.Sc., LL.D., Director, World Land Use Survey. R. O. Buchanan, M.A., B.Sc.(Econ.),

Ph.D., Professor of Geography, The London School of Economics and Political Science, in the Chair. (Tea will be served in the Library from 4.30 p.m.)

WEDNESDAY, 31ST DECEMBER, at 2.30 p.m. JUVENILE LECTURE. '*Success with a Camera*', by Stanley J. Coleman, F.I.B.P., F.R.P.S., Head of School of Photography, The Polytechnic, Regent Street. (*Fellows require special tickets of admission; see Notice on p.6.*)

MONDAY, 5TH JANUARY, at 6.30 p.m. FILM EVENING. The programme will include *Journey into Spring* (which won the British Film Academy award for the best documentary produced anywhere in 1957); *Romance of Transportation; The Shepherd; The Bats.* Light refreshments will be served in the Library from 5.45 p.m. Full details of the Programme will be given in the next issue of the *Journal.*

WEDNESDAY, 7TH JANUARY, at 2.30 p.m. JUVENILE LECTURE. '*From the Jungle to the Zoo*', by George Cansdale, B.A., B.Sc., F.L.S. (*Admission by special ticket, as for the first Juvenile Lecture.*)

WEDNESDAY, 14TH JANUARY, at 2.30 p.m. '*Films in Alliance with Industry*', by Edgar Anstey, Films Officer, British Transport Commission. George Pollock, Q.C., Director, British Employers' Confederation, in the Chair.

THURSDAY, 15TH JANUARY, at 5.15 p.m. COMMONWEALTH SECTION. '*Road Development in the Overseas Territories*', by R. S. Millard, Ph.D., Head of Colonial Section, Road Research Laboratory, D.S.I.R. Sir Reginald Taylor, C.M.G., Engineer-in-Chief, Crown Agents for Overseas Governments and Administrations, in the Chair. (Tea will be served in the Library from 4.30 p.m.)

WEDNESDAY, 21ST JANUARY, at 2.30 p.m. '*Technical Education: a Prognosis*', by the Right Honble. Lord Nathan, P.C., T.D., D.L., J.P., F.S.A., President, Association of Technical Institutions. R. W. Holland, O.B.E., M.A., M.Sc., LL.D., a Vice-President of the Society, in the Chair.

TUESDAY, 27TH JANUARY, at 5.15 p.m. COMMONWEALTH SECTION. THOMAS HOLLAND MEMORIAL LECTURE. '*The Commonwealth Transantarctic Expedition*', by Sir Vivian Fuchs, M.A., Ph.D. The Right Honble. Lord Cohen of Birkenhead, M.D., F.R.C.P., in the Chair. (Tea will be served from 4.30 p.m. in the Library. *Fellows who wish to be sure of seats for this Meeting are advised to apply for special tickets, and in doing so to state whether they will be accompanied by one or two guests.*)

WEDNESDAY, 28TH JANUARY, at 2.30 p.m. FRED COOK MEMORIAL LECTURE. '*Illusionist Decoration of the Italian Renaissance*', by Sir Anthony Blunt, K.C.V.O., Professor of the History of Art, University of London, and Director, Courtauld Institute of Art. Ellis K. Waterhouse, C.B.E., M.A., Barber Professor of Fine Arts, and Director of the Barber Institute, University of Birmingham, in the Chair.

Fellows are entitled to attend any of the Society's meetings without tickets (except where otherwise stated), and may also bring two guests. When they cannot accompany their guests, Fellows may give them special passes, books of which can be obtained on application to the Secretary.

JUVENILE LECTURES

Special tickets for the Juvenile Lectures announced on page 5 will shortly be available, and will, when ready, be sent to Fellows on request as far as the accommodation of the Lecture Hall permits.

Fellows are entitled to apply for tickets admitting one adult and two children to each lecture, and should state their exact requirements within these limits when making application.

THE SECRETARY'S VISIT TO NORTH AMERICA

In the autumn of 1954 an enterprising group of Canadian Fellows sought the Council's permission to arrange a Banquet in Toronto in continuation of the Bicentenary celebrations which had taken place earlier that year in London. The Council readily gave their approval, and the banquet was ultimately held at the Royal York Hotel, Toronto, on 19th February, 1955: the first official gathering of the Society to take place overseas.

In this simple and natural manner a significant change took place: the Society, *as a society*, came alive in North America, where, in fact, nearly one-tenth of its membership actually lives. It was a development which gave great pleasure to the Council and they have sought ever since to foster it. As a first step they appointed Honorary Corresponding Members to cover most of the major areas of Canada, and the North-Eastern States of the U.S.A., and this summer they felt that the time had arrived to send the Secretary on a second visit, to seek by appropriate means to extend and deepen what was thus auspiciously taking place. As a further gesture of good will they invited Mrs. Luckhurst to accompany her husband.

The Secretary and his wife arrived in New York in the *Nieuw Amsterdam* on Wednesday, 24th September, and stayed in that area until the following Wednesday. This period allowed for valuable discussions with Professor Simon Lissim, the Honorary Corresponding Member, and other Fellows, and small parties were very kindly given to the visitors in New York City and Dobbs Ferry, and in Connecticut, by Professor and Mrs. Lissim and Mr. and Mrs. H. A. Newman.

Dr. and Mrs. Luckhurst then passed on, with a brief stay *en route* at Philadelphia (where they had an opportunity of visiting the Franklin Institute), to Washington, D.C., where they were welcomed at a reception most kindly given at their home in Georgetown by Mr. and Mrs. D'Arcy Edmundson, and attended by a most encouraging number of Fellows, several of whom had travelled for the occasion from Baltimore and other places in Maryland.

From Washington Dr. and Mrs. Luckhurst then moved northwards to Toronto where, after a few days spent in personal contacts, the Secretary left his wife in the good keeping of her brother, while he himself flew to visit Fellows in the West.

He arrived in Victoria on a misty afternoon to find that Squadron-Leader Goode, the Honorary Corresponding Member, had arranged a full programme for his brief stay in British Columbia. On Sunday, 12th October, Thanksgiving Day, he was privileged, through the courtesy of Colonel Cooper, the Commandant, and Professor A. L. C. Atkins, to attend the Thanksgiving service at the Royal Canadian Combined Services College at Royal Roads; being afterwards entertained to luncheon and shown round the College, which shares with so many education buildings in Canada its dignified spaciousness and fine equipment, but is surely unsurpassed anywhere in the beauty of its setting. The following day brought a distinctly varied programme. In the morning, the Secretary was escorted by Squadron Leader Goode and Mr. H. H. German to Government House (which, owing to the recent destruction by fire of Government House proper, proved to be a suite in his hotel on the same floor as his own room!), and he was received with great kindness by the Lieutenant-Governor of British Columbia, the Honble. F. M. Ross, C.M.G., M.C. The afternoon was spent in salmon-fishing as the guest of Mr. and Mrs. German, and the final event of the day was a party in the late evening at the home of Squadron-Leader and Mrs. Goode, when the Fellows in the Victoria area, with their wives and a number of friends, gathered to bid Dr. Luckhurst farewell. The following day, Squadron-Leader Goode and Mr. and Mrs. German crossed with the Secretary to the mainland, where, through the kindness of the President of the University, Dr. N. A. R. Mackenzie (who is a Fellow), a luncheon party was given at the Faculty Club of the University of British Columbia. This was followed, after a tour through Stanley Park, by a tea-party at the home of Mrs. Maltwood, who showed the company a number of her remarkable paintings of North American Indians.

Dr. Luckhurst's next destination was Edmonton, where he was again guest of honour of a University, this time at a dinner presided over by the Vice-President, Dr. W. H. Johns. It was a great surprise to find such a company (brought into the Society's membership largely through the efforts of the Honorary Corresponding Member, Dr. Hedley) in what previously, to untutored eastern eyes, had seemed a remote corner of the prairies, but is now in fact one of the most prosperous and expansive cities of the Dominion.

On his return by air to Toronto, Dr. Luckhurst rejoined his wife for the busiest part of their programme. On Monday, 20th October, a dinner had been arranged in their honour by the Honorary Corresponding Member, Mr. S. Conder, at the King Edward Sheraton Hotel. Over 30 Fellows, a number accompanied by their wives, were present to meet them. The Anglo-Canadian character of the gathering was further strengthened by the presence of a member of the Society's Council, the Honble. G. C. H. Chubb who, with Mrs. Chubb, had arrived from New York that afternoon, and who made a short speech after dinner.

The following day Dr. and Mrs. Luckhurst visited London, Ontario, where it was their privilege to be welcomed at a luncheon party of Fellows by Colonel W. J. Brown, the senior Honorary Corresponding Member in Canada and the

first overseas Vice-President of the Society. Wednesday, 22nd October, which was spent in Ottawa, culminated in a dinner party for Fellows and their wives, kindly arranged by Dr. E. P. Weeks, and the remainder of the week was spent in Montreal, where, as the result of an invitation distributed on their behalf by Colonel Brown, nearly half the considerable total of Montreal Fellows kindly called to see them at their hotel.

This was indeed a most encouraging conclusion to the Canadian visit, and on Saturday, 25th October, they re-crossed the border into the United States on their way home. They spent the weekend with Colonel and Mrs. J. R. Appleton, jun., in their charming and historic home near Ipswich, Massachusetts, and the Secretary had an opportunity of renewing his acquaintance with several Fellows in the Boston area before returning to New York. Here, on Tuesday, 28th October (the eve of their sailing in the *Queen Mary*), Professor Lissim had arranged a grand send-off for the visitors in the form of a luncheon which was attended by forty Fellows, the largest gathering of the kind which has yet taken place in the United States.

But the final act of 'farewell' was quite unplanned: after luncheon, when Dr. and Mrs. Luckhurst returned with Professor and Mrs. Lissim to the foyer of their hotel, they had an opportunity of exchanging waves and smiles with the President of the United States himself, who was arriving for a meeting in one of the hotel rooms. They feel that Fate had contrived for them a charming acknowledgement of the pilgrimage which they had paid to the home and tomb of the great first President, a month before!

The compiler of this report feels that it must read as the record of one enormous round (14,000 miles long, all told) of parties and sightseeing! There were, in fact, many quieter and more serious moments, and in any case his readers in North America must share the blame for this festive note, through their great gift for hospitality! Dr. Luckhurst would like to take this opportunity of expressing his wife's and his own gratitude for all the kindness and helpfulness which were shown to them both wherever they went. And while they have been fortunate enough to be the personal recipients of all this wealth and warmth of friendliness, they are also cheered by the consciousness that they have received it on behalf of the Society as a whole, and of the Council which entrusted this mission to them. It is their hope that they may thus have done something to foster the personal links between members which should characterize any body which calls itself a 'society', as well as to strengthen the devotion to the aims of the Society, which is what originally brings the members together. *Faber fabrum adjuvet.*

DEATH OF SIR WILLIAM HALCROW

With great regret we record the death of Sir William Halcrow, M.I.C.E., M.I.Mech.E., on 31st October, at the age of 75. He had served on the Council *of the Society in 1946–7, and continuously since 1956.*

William Thomson Halcrow was educated in Edinburgh, at George Watson's

College and the University, and subsequently articled to P. W. and C. S. Meik, in whose service he gained valuable early experience of harbour and water-power works on the Continent and in Scotland. In 1910 he became Chief Engineer on the King George V graving dock at Singapore, and after the First World War —during which he was chiefly occupied with the submarine defences at Scapa Flow—he returned to the Far East to take charge of the construction of the Johore Causeway and Ship Dock.

Halcrow came back to Scotland in 1921 to enter into partnership with C. S. Meik. After the latter's death he became senior consultant of the firm, which subsequently took his name and developed a leading practice. Halcrow's professional skill came to be sought in many countries, and from an impressive list of his pre-war undertakings one may single out the design and construction of the port at Beira in Portuguese East Africa, and the Lochaber, and Caledonian and Glen Affric, water-power schemes. These were all tasks of national significance. It was characteristic of Halcrow's attitude to engineering that he was not only actively associated with its professional organization and well-being —he was past President of the Institution of Civil Engineers, and past Chairman of the Association of Consulting Engineers—but found the time for a great deal of direct public service. As joint consulting engineer to the London Passenger Transport Board he carried out large-scale extensions of the tube railway. During the recent war his knowledge of tunnel construction proved invaluable in the design of deep shelters. He served on the War Cabinet Engineering Committee, and was Chairman of the panel of engineers who designed the Mulberry Harbour. Knighted in 1944, in the same year he chaired the Committee which reported on the practicability of the Severn Barrage. He examined this and other tidal power schemes in a Cantor lecture delivered to the Society not long afterwards.

In his later years Sir William spent much time in Central Africa, where he advised upon the Kariba and Karifue schemes and upon hydro-electric works envisaged by the Government of Nyasaland. He gave a valuable first-hand account of these projects to the Commonwealth Section in 1954.

No one meeting Sir William Halcrow could fail to sense his gentleness of character. He delighted in the exercise of his profession alike for its own sake, as a tax on his powers of contrivance, and as an essential agent of material progress. About his own achievements he was truly modest; it rests with his contemporaries and successors to acknowledge their quality.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 10th November, 1958. Present: Sir Alfred Bossom (in the Chair); Mrs. Mary Adams; Dr. W. Greenhouse Allt; Sir Hilary Blood; Sir Edward Crowe; Mr. R. E. Dangerfield; Sir George Edwards; Mr. P. A. Le Neve Foster; the Earl of Halsbury; Dr. R. W. Holland; Lord Latham; Mr. E. E. Lawley; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. O. P. Milne; the Earl of Radnor; Sir Gilbert Rennie; Mr. A. R. N. Roberts;

Sir Selwyn Selwyn-Clarke; Mr. G. E. Tonge; Mr. H. A. Warren; Sir Griffith Williams; Miss Anna Zinkeisen; with Dr. K. W. Luckhurst (Secretary), Mr. G. E. Mercer (Deputy Secretary) and Mr. J. S. Skidmore (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Barry, James, M.R.C.S., L.R.C.P., London.
Carmichael, Harry John, C.M.G., St. Catharines, Ontario, Canada.
Cheung, Mrs. Ng Fook-yuen, Hong Kong.
Drake, Kenneth Douglas, London.
Durrans, Eric, N.D.D., Bath, Somerset.
George, James Arthur Anderson, Victoria, B.C., Canada.
Goldfinch, Donald Albert, E.R.D., F.R.I.B.A., Birmingham.
Higgins, Kenneth Gordon, F.R.I.C.S., London.
Iredale, John Arthur, A.T.I., Halifax, Yorkshire.
Kinmont, David Bruce, N.D.D., A.T.D., Shotton, Chester.
Kyi, U Ba, Washington, D.C., U.S.A.
Lasserre, Professor Frederic, B.Arch., F.R.A.I.C., Vancouver, B.C., Canada.
O'Brien, Kenneth Dalziel, Reading, Berkshire.
Pell, Miss Catherine Mary, Burton-on-Trent, Staffordshire.
Sheridan, Edward, Maidstone, Kent.
Stocker, Geoffrey G. L., London.
Stinchcombe, Francis Joseph Milne, Hythe, Kent.
Stone, George Howard, Folkestone, Kent.
Turner, Bill Ralph, Cheadle Hulme, Cheshire.
Twining, Alfred Geoffrey Matley, A.M.I.E.(Ind.), Calcutta, India.
White, Douglas, A.C.A., Windermere, Westmorland.
Wood, Desmond Porteous, Gravesend, Kent.
Wright, Cecil Frank, A.R.I.B.A., Liverpool.

The following was duly elected an Associate Member:

Hazell, Miss Joy Catherine, Bath, Somerset.

SECRETARY'S VISIT TO NORTH AMERICA

Consideration was given to a report by the Secretary on his recent visit to North America.

FUTURE DEVELOPMENT OF THE SOCIETY

A Committee of the Council was appointed to review the present activities of the Society and to make such representations for the future as it considered appropriate.

NATIONAL BOOK LEAGUE

Professor R. D. Russell, R.D.I., F.S.I.A., was reappointed as the Society's representative on the National Council of the National Book League.

SWINEY CUP 1959

Three members were appointed to represent the Society on the joint committee of the Society and the Royal College of Physicians which will receive the report

of the Judges and decide on the award of the 1959 Swiney Prize for medical jurisprudence.

EXAMINATIONS

It was reported that the number of entries received for the Autumn series of examinations was 28,288, an increase of 7,341 over the number for the corresponding series in 1957.

OTHER BUSINESS

A quantity of financial and other business was transacted.

THE SOCIETY'S CHRISTMAS CARD

Fellows who intend to purchase the Society's Christmas Cards but have not yet done so are urged to place their orders without delay, as the limited number in stock is rapidly dwindling. An order form—the last which can be distributed in the *Journal* before Christmas—is included at the back of this issue. A specimen card will be sent on request.

INDUSTRIAL ART BURSARIES EXHIBITION

The exhibition of designs submitted in the 1957 Industrial Art Bursaries Competition will be shown by the Carlisle College of Art at the Public Library, Museum and Art Gallery, Tullie House, Carlisle, from 15th December, 1958 to 3rd January, 1959.

JOURNAL INDEX AND BINDING CASES

The index and title-page for Volume 106 of the *Journal* are in preparation and will shortly be available, free of charge, to Fellows who ask for them. Orders for binding-cases (with which copies of the index and title-page are supplied as a matter of course) price 7*s*. each, post free, should be sent to P. G. Chapman & Co., Ltd., Kent House Lane, Beckenham, Kent, who will also undertake the work of binding at an additional cost.

THE CHALLENGE OF THE FUTURE

The Inaugural Address of the 205th Session by

SIR ALFRED BOSSOM, Bt., LL.D., F.R.I.B.A., J.P., M.P.,

Chairman of Council of the Society, delivered to the Society on Wednesday, 5th November, 1958

When studying mankind's progress through the centuries, it is difficult to avoid the conclusion that it has seldom been possible to foresee what would be happening in the years ahead. The future has always been a mighty riddle, but with each new era its solution becomes more complex. This is part of the Challenge of the Future that man is facing.

It would seem that at present we can look towards a greater variety of possibilities than ever. The world is split by political ideologies—on one side a free world, on the other the philosophy of the Communist. Something like 1,000 million human beings are daily being led to believe that the remainder of the world's people are not producing the essentials for their own existence, and consequently should be destroyed or disorganized, or put under the domination of that section of the world which believes in a Communist way of life. The principle that peace-loving Christian people should have the right to lead their own lives, moving about the world in safety and living free from arbitrary controls when conducting themselves in a normal law-abiding manner, is not accepted by the Communists, whose leaders continuously preach to their fellows that the rest of humanity are parasites battening on the good things provided by the Communist world. Day and night this Communist section of humanity is fed with propaganda through the medium of the radio, television, the human voice—in fact, by any means available.

Surely the only way to counter this doctrine is by the positive action of creating all the needed articles, the systems or policies, in less time and at lower cost than the Communists can produce them? If this is done, inevitably knowledge of the achievement will in time percolate through the Iron Curtain.

Here is a constructive challenge and here also is an opportunity for the Royal Society of Arts to help in meeting it, thereby and at the same time benefiting the free world.

By spreading news of the latest developments (inventions and discoveries that all those working for peace can and will make from their own intelligence and resources) we shall prove everywhere that a free world is capable of looking after itself and, if need be, of helping others.

It is along such paths of constructive educational policy that the Society has moved forward, and by steadily widening its programme of activity it can continue to make a valuable contribution to the welfare of the civilized world.

More than two centuries ago, on 24th March, 1754, at Rawthmell's Coffee

House, Henrietta Street, Covent Garden, a group of private individuals banded together for the purpose of encouraging the development of the arts, manufactures and commerce. This same ideal has continued to inspire many men and women to give of themselves freely under the aegis of this Society, first by gathering accurate and advanced knowledge, and then spreading this for the advantage of others, by means of papers read in this historic Lecture Hall of the Society, by the discussions which these have stimulated and by the subsequent publication of these proceedings in the Society's *Journal*. This activity undoubtedly has made a substantial contribution to universal knowledge.

From its earliest years, the Society's efforts to collect and publicize data which could provide a basis for improvement in such fields as agricultural methods, industrial relations, and many others, have undoubtedly assisted progress at home, in the Commonwealth, and often in foreign lands. In fact, during the last two centuries the Society has become, in the broadest sense, a stimulus to invention, and a source of enlightenment about the world's achievements.

The British Royal Family has taken a lively interest in this work and the Society has not only been honoured, during the last half century, by the patronage of the Sovereign, but since 1816 has also enjoyed the favour and counsel of seven Royal Presidents.

In 1851 Prince Albert, then President of the Society, actively fostered the Great Exhibition of All Nations, the purpose of which was to encourage art and industry on an unprecedented scale. This gave a mighty boost to the commerce of the world. Prince Albert's leadership in this venture had the enthusiastic support of many members of the Society.

The 1851 Exhibition proved to be a stimulant to the better design of many materials such as glass, cutlery, silversmiths' work, furniture, wall-papers, book-binding and innumerable others; in fact, the Exhibition included over 15,000 exhibits from all over the world.

In accordance with the progressive spirit of the times (that later possibly inspired the exhibition), the Society decided in 1841 to institute a Committee (subsequently called the Webster Committee) with the following terms of reference:

> to take into consideration the original objects of the Society, the manner in which these objects had been interfered with by other societies, the field which is now open for its labours and the means by which the Society could be rendered more efficient as regards its objects, constitution and management, and to report generally on the means of increasing its usefulness and on the course which they would recommend to be adopted.

That Committee consisted of nine members, with Sir Thomas Webster as Chairman. In its Report, presented to a full meeting of the Society on 15th December, 1841, it recommended that the administrative business of the Society should be delegated to a Council. The adoption of this proposal led to the creation of the Council almost as it exists to-day, and ultimately to the grant of the Royal Charter.

Steadily the Society's interests have widened, but though adapted to prevailing needs they have always broadly reflected the declared objects of the original group of members.

Reverting a little in time—after 1830, the Society's *Transactions* were published at somewhat irregular intervals, but in 1845 a regular weekly publication was started. At first, this consisted of but a few pages of notices and general information about the Society, but from 1848 it contained extracts from Papers that had been read and discussed. Its title was then changed to *Weekly Proceedings*, but in the issue of 12th June, 1852, an announcement appeared that 'the Council was considering the publication of a stamped weekly *Journal*'. A few months later, on 26th November, 1952 (a memorable date in the Society's history), the first number of the *Journal* was published.

Since then, the vicissitudes of the times, especially the two great wars, have temporarily influenced the situation, but the Society's work as a whole has continued to become more and more comprehensive.

Every year papers on subjects of marked public interest or need pertaining to the arts, manufactures and commerce have been read in the Lecture Hall by the men possessing extensive knowledge of the many subjects, and the great majority of papers have been followed by discussions. The record of these meetings is now circulated literally round the world to over 6,000 subscribing Fellows of the Society and to certain other interested Bodies.

The Committee of Council members which selects the papers welcomes ideas and suggestions from any Fellow, and it has always been its policy to invite the best available authority on a given subject to read the chosen paper.

Lectures and discussions are but one manifestation of the work done by the Society. Its responsibility as an effective examining body has been nationally recognized and it holds examinations four times a year, mainly on commercial subjects and modern languages, and grants Certificates to the successful candidates. In 1957–8 the number of subject entries totalled approximately 270,000, including over 25,000 from the Commonwealth. For these, some 200 question papers were prepared. The Certificates granted by the Society are respected by government departments, technical authorities, learned bodies and industrial concerns wherever English is spoken.

Also, other activities of the Society are Conferences, held on matters of national interest, such as the training of industrial apprentices, which incidentally raises some special problems to-day. So does the existing system of training for those intending to follow the artistic crafts: this has been found to leave a hiatus between the end of formal study in classes and the time when the student becomes an asset in the manufacturing concern by which he is employed. In an attempt to broaden the experience of young designers, the Society, with the support of the many industries concerned, instituted a series of Industrial Art Bursaries Competitions. The successful candidate in each section of the Competition is enabled to travel and acquire first-hand knowledge of what is being done in other countries, and it would be hard for a student to gain such useful knowledge by any other means. Designs by the successful and commended

students are exhibited in the Society's House and later circulated to other cities to encourage more competition in succeeding years.

Other Exhibitions have hitherto been held in the Library, but with the new additional space now available, this side of the Society's activities will be considerably extended. As a matter of fact, during the last two years the Society has greatly enlarged its space by acquiring the adjacent premises, which were designed (as was the Society's own House) by the Adam brothers. This extension will provide room for larger exhibitions, more conferences, and for improved accommodation for Fellows.

Many other Societies have come into being under the auspices of the Royal Society of Arts, such, for example, as the Chemical Society, the Royal Photographic Society, the Institution of Naval Architects and the Modular Society, all of which held their early meetings here. Surviving Societies to which the Royal Society of Arts gave generous financial help are the Royal College of Music (formerly the National Training School for Music) and the Commonwealth Institute (formerly the Imperial Institute).

Constant care is taken by the Society to ensure that all new developments in the arts, manufactures and commerce should receive consideration. But, living as we are in an age of scientific marvels—such as television; jet planes, which have suddenly come into service and made the world in effect half its former travel size; atomic energy, which has many uses apart from its significance in warfare; automation and computers, all rapidly increasing in public use—it must be accepted that we cannot surmise what may be ahead of us now. All the new inventions must affect our lives in some way.

How then can the Society best shape its course to be able to give to all those interested the fullest review of facts about the many scientific and other advances existing and to come, as it has so consistently done over the last two centuries?

I suggest that the time may well have come when, fortified by the example of an alert and forward-looking President, H.R.H. the Duke of Edinburgh, we should examine our present activities to make certain that the Society's aims are being pursued in the most effective and rewarding manner. From even a preliminary review certain needs and possibilities have suggested themselves.

First, it does seem desirable that the Society should extend and increase its membership not only in Great Britain but also throughout the Commonwealth, the United States and Europe. To encourage such an increase in membership, papers and discussions would certainly have to meet not only British requirements and interests but equally those of many other countries. To this end, consideration might well be given to a policy of deciding upon the main Lecture programmes a year in advance of presentation. To facilitate such a plan, of course, the subjects would have to be of material interest overseas, and overseas Fellows should be encouraged to make even greater use of their present opportunities for proposing subjects for the speakers, advising whether a lecture should be illustrated, and so forth.

To ensure as wide a distribution as possible of such material presented here, we should take advantage of the latest modes of presentation by the visual aids

to enhance the results obtained by the normal verbal delivery. In addition to having papers printed in the *Journal*, tape-recordings of all or part of some of them should be made, and film-strips prepared when appropriate. These recordings and film strips could be circulated, when and where thought fit, to universities, colleges or even senior schools and other interested bodies, and to local authorities, on mutually satisfactory terms for still wider benefit. For non-English-speaking peoples the lectures could, of course, be translated into the desired languages. Where news of the paper is to be circulated so far in advance of actual delivery, the necessary editing would also have to be done at an early stage, but in the case of discussions taking place after presentation obviously many authors may like a preview before the recordings are publicized or distributed.

In the case of special papers or tape-recordings, etc., when given in the United States of America for educational bodies or groups, an American expert could start the discussion, and this should be published in the *Journal* at the same time as the British discussion. Exchange of speakers should be considered.

Great efforts should be made to increase the scope of the Industrial Art Bursaries Competitions possibly in other parts of the Commonwealth, and more comprehensive, constructive and detailed reports about them should appear in the *Journal*. Similar competitions, too, might well be encouraged overseas. Papers on the subjects for which the Bursaries are awarded would be of particular interest to competing students and to the commercial firms and schools where students are working, for studying the subjects under consideration.

Lectures should be delivered on the financial background and implications of industry and industrial development, on the trade aspect, and on the methods of distribution, and no doubt many such matters will be proposed by the Special Activities Committee, having the widening of the Society's influence in view.

Particularly where considerable advances are taking place in the fields of the arts, manufactures and commerce, careful thought should be given to a planned series of papers covering many subjects, and these, of course, should be delivered by the leading national authorities in every instance; should lack of time prevent the delivery of these lectures by the actual writers, the texts could still be included in the *Journal*.

Many ways of spreading the knowledge suggest themselves. Not only should the full script of lectures be given to the technical Press, but a précis of matters of public interest should be sent more widely to the national Press.

A further change might well be considered to cover the field of technical innovation and progress more completely; for instance, co-operation with a limited number of other learned societies might help to avoid the duplication of subjects, and an exchange of papers between such bodies and the Royal Society of Arts might promote more nation-wide education on important matters: with permission, and giving full credit, the papers might also be printed in this Society's *Journal*, so making it an even more comprehensive source of information. This development would necessitate a cautious approach, to ensure that it did not interfere with the general policy of this Society. Another point for

consideration is that such other organizations might wish to publish a limited number of the Society's papers, or parts of them, in their own journals, with appropriate acknowledgment.

The value of better design in goods is becoming recognized more and more each day, and this, coupled with the increasing ability to transfer goods at great speeds and at reasonable cost by carrier aircraft, makes it more than ever essential now to give careful consideration to the possibilities I have outlined.

Another fruitful extension of the Society's activities could well be the development of many more exhibitions of commercial subjects, made possible by the greatly improved facilities available to the Society of to-day. Such exhibitions could often be so arranged as to be then circulated throughout the country or even the Commonwealth, etc. A natural corollary of these exhibitions might well be a few papers read by experts on subjects related to artistic commercial exports and presentation, covering the legal or other possible limitations upon them.

It does seem that attempts to meet the *Challenge of the Future* should be of a gradual nature, for breaking with a hundred years of tradition is not something to be undertaken lightly, and any action taken should be rhythmic and in harmony with the intention of our founders and the terms of our charter. Though the time has come for a careful review of all procedures and advances, they should be of an elastic nature, to enable adjustments to be made smoothly, when desirable, without any undue disturbance of customs that have long proved satisfactory but are now perhaps a little time-worn. I have taken this opportunity to put forward for consideration suggestions for some future activities of the Society in the hope that they may at least be felt worthy of future examination—and, much more important, may induce other people to make suggestions.

At the conclusion of his Address, THE CHAIRMAN *proceeded to the customary presentation of the Society's awards. He first presented Silver Medals awarded for outstanding papers read during the past Session to the following:*

For Papers read at Ordinary Meetings

Sir Gavin de Beer. '*The Inhabitants of Switzerland*'
Charles Hadfield. '*The Brussels Universal and International Exhibition* 1958'
J. R. James. '*Land Planning in an Expanding Economy*'
Dr. A. S. Laughton. '*Exploring the Deep Ocean Floor*'
Professor V. de S. Pinto. '*William Blake: the Visionary Man*'
Sir John Taylor. '*British Trade with Latin America*'

For Papers read at Meetings of the Commonwealth Section

His Excellency Edward O. Asafu-Adjaye. '*Ghana*'

The following lecturers, who had also been awarded Silver Medals, were unable to be present to receive them in person but were represented by deputies:

Ordinary Meetings

Laurence Irving. '*Setting the Stage*'

Commonwealth Section

The Honble. F. W. Bulcock. '*The Pastoral Industry of Australia*'

Next, THE CHAIRMAN *presented a* THOMAS GRAY MEMORIAL TRUST *Silver Medal to:*

G. L. Danton, *for obtaining the highest marks in the 1957 Ministry of Transport Extra Master Examination*

Then THE CHAIRMAN *presented a* FOTHERGILL PRIZE *of £10 to:*

E. C. Simpson, *for his essay, 'Special Hydrant-Indicating Nails'*

Finally, THE CHAIRMAN *presented the* SIR FRANK WARNER MEMORIAL MEDAL *to:*

Fred Whitehead, *for the best design submitted in the Textiles Sections of the 1957 Industrial Art Bursaries Competition*

DR. R. W. HOLLAND, O.B.E., *then spoke as follows:*

I have the privilege of proposing a vote of thanks to Sir Alfred Bossom. You have seen him in action in the paper that he has read to us; you have also seen the pleasant manner in which he handed out the awards for various achievements—and, Ladies and Gentlemen, he is always like that! It has been a privilege to sit under him as Chairman of the Society, and it is a pleasure as well as a duty for me to say that our thanks are due to Sir Alfred for his twelve months Chairmanship. We look forward to an increase in his activities, if that were possible, during the coming Session of the Society's work.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C., *then said:*

It gives me great pleasure, on behalf of the Commonwealth Section, to second the proposal. There were, Sir, two points in your very interesting and provocative speech which I should like to take up. You mentioned that about 25,000 out of 270,000 examinees this year came from the Commonwealth. I think that shows the influence of the Society in the Commonwealth. The second point, Sir, was that in your invitation to all of us to put forward ideas you included our members in the Commonwealth territories—I do hope, on behalf of the Society and on behalf of the Commonwealth Section, that we shall have a generous flow of ideas. I now second the proposal that we thank Sir Alfred Bossom very warmly for his paper and for presenting the prizes and awards this afternoon.

The vote of thanks was carried with acclamation, and THE CHAIRMAN *thereafter said:*

Thank you very much, Dr. Holland and Sir Selwyn. I am afraid you are far too good to me, but I appreciate very much what you have said, and I hope I can live up to it. It is not an easy task—as you know, Dr. Holland—to be Chairman of Council of the Royal Society of Arts. I hope to do the best that my abilities will permit.

The formal proceedings then ended, and the company adjourned to the Library, where tea was served.

MODERNIZING THE RAILWAYS—MOTIVE POWER AND OPERATION

A paper by

CECIL J. ALLEN, M.Inst.T., A.I.Loco.E.,

read to the Society on Wednesday, 12th November, 1958, with G. E. Tonge, Director and General Manager, Hay's Wharf Ltd., and a Treasurer of the Society, in the Chair

THE CHAIRMAN: The railways are very much in the news at present and I think there could hardly be a more timely or more appropriate subject for a lecture delivered under the auspices of the Royal Society of Arts. Whatever our views as to what might be done about their present situation, I would hazard a guess that all of us in this room agree that modernization can reduce railway costs and improve their efficiency. It is, therefore, with very much pleasure that I introduce Mr. Cecil J. Allen. Mr. Allen, a Past-President of the Railway Club and for many years a contributor to various railway and other publications, including the *Railway Magazine*, is probably widely known to most of us through his most excellent monthly articles on 'British Locomotive Practice and Performance' in that periodical. He tells me that the November issue of the *Railway Magazine* contains his 534th consecutive article. That is no mean achievement.

The following paper, which was illustrated with lantern slides, was then read:

THE PAPER

It would be no exaggeration to say that the £1,200,000,000 railway modernization and re-equipment plan of the British Transport Commission, first made public in 1955, offers the greatest opportunities of technical advance that the railways of Britain have enjoyed in all their long history. As yet barely four years have elapsed of the fifteen years over which the work is to be spread, but the general pattern is now becoming more clear, and some of the more revolutionary changes already are in evidence. Within the limits of this paper it would be impossible, of course, to deal with the vast range of the modernization as a whole, and it is therefore necessary to confine our survey to one of the most important aspects, which is motive power.

To many observers one of the most startling revelations of the plan has been the decision to bring to an end the building of steam locomotives and eventually to abandon steam traction altogether. The steam locomotive, robust in construction, adaptable to a great variety of duties, and even when in a run-down condition still capable of doing useful work, has been a wonderful servant. If for no other than sentimental reasons, many of us will greatly regret its disappearance; but the decision is inescapable. In some other countries it was reached some time ago, and steam traction on railways already is at an end, or very nearly so.

The first reason for the decision relates to the narrow confines of the railway loading gauge, governed by bridges, tunnels, platforms and other lineside structures. Within the maximum dimensions permissible, the steam locomotive has reached the limit of its cross-sectional development. While this has not yet proved a controlling factor in British railway operation, in which the more powerful passenger and freight locomotives are still well able to handle the most exacting assignments, it may not be so with the higher speeds contemplated in the future. In the United States, where in modern conditions continuous runs of 1,000 to over 2,000 miles are required without change of locomotive, and where freight trains of from 100 to 150 bogie wagons and over are now common over certain main lines, the largest steam locomotives are no longer adequate. Even such immense machines as the 540-ton Union Pacific articulated locomotives of the so-called 'Big Boy' class are outclassed by present power demands.

The second reason relates to fuel. It is that the steam locomotive thermally is an inefficient user of coal. Due to the cross-sectional limitations already mentioned, and also, for track reasons, to limitations of weight per foot run, the boiler is so restricted in dimensions that it is required to produce steam at a faster rate than any other boiler of comparable size. Forced draught is therefore essential; and over the past 130 years no better means has been found of providing it than that used by George Stephenson in the 'Rocket'—by turning the exhaust steam from the cylinders up into the chimney and thereby providing the necessary suction to draw the hot gases from the firegrate through the boiler-tubes to the smokebox. The maximum possible use is made of expansion in the cylinders, but there must still be sufficient terminal pressure in the steam on exhaust to provide adequate draught, which means that a certain proportion of the energy in the steam is being thrown away. Due to the shortness of the boiler barrel, unused heat passes out of the chimney also. Mainly for these reasons, the overall thermal efficiency of the steam locomotive of traditional design, even in the best conditions, does not exceed 8 per cent and the average is more like 5½ per cent.

Various attempts have been made in the past to increase these figures. Turbine propulsion has been tried in place of cylinders and reciprocating motion, and turbo-condensing locomotives built in Sweden to the Ljungström patents have attained an overall thermal efficiency of nearly 15 per cent. In 1926 a locomotive of this type was built in this country by Beyer Peacock & Company, and underwent extensive and fairly successful trials on the Midland main line of the L.M.S.R.; but various modifications were needed, and as the firm was not prepared to go on experimenting indefinitely without any promise of financial assistance from the railways, the experiment came to nothing.

An obstacle to condensing on a turbine locomotive is the weight and bulk of an adequate condensing plant; so, when the L.M.S.R. produced its own turbine-driven locomotive in 1935, it was equipped with a turbine exhausting directly to atmosphere. Although No. 6202 performed capably on some of the fastest schedules of its time, by the absence of condensing it was deprived of one of the

principal aids to higher efficiency, so that the savings in fuel were not sufficient to balance the higher constructional cost. Tests continued over a lengthy period, but after a number of failures in service, some of them serious, the experiment was abandoned, and No. 6202 was rebuilt in a conventional form. Since then a further experiment in turbine propulsion has been made, by the Norfolk & Western Railway of the United States—the last stronghold of steam in that country—in the form of a condensing turbine driving an electric generator, and with propulsion by traction motors, but this extraordinarily cumbrous machine did not give the results anticipated, and has been unable to stem the relentless advance of diesel-electric traction.

Higher working pressures have been another temptation to locomotive engineers, in their endeavour to increase thermal efficiency by making better use of the expansive properties of the steam. In Great Britain, in the past, the lead in this direction was given by Churchward and his successors on the Great Western Railway, with working pressures of 225 lb. per sq. in. in the earlier 4–6–0 locomotives of that company and of 250 lb. in the 'Kings'. Such pressures, coupled with long-lap long-travel piston-valves, large cylinder ports, and improved front-end design generally, made it possible for engines to be worked on fast and heavy duties with wide open regulators and cut-offs reduced to 15 per cent or so, with a correspondingly beneficial effect on thermal efficiency figures. The historic exchange trials of G.W.R. 'Castle' class locomotives with L.N.E.R. Pacifics in 1925 and with L.M.S.R. locomotives in 1926 proved beyond question the superiority of these Great Western principles of design and had a considerable effect on British locomotive design in general from that time onwards.

With locomotives of traditional design working pressures up to 300 lb. per sq. in. have been used, more particularly in the United States, but still higher pressures have necessitated unusual designs. In 1929 4-6-4 locomotive No. 10000 was turned out of Doncaster Works of the London & North Eastern Railway with a marine water-tube boiler of the Yarrow type in place of the conventional locomotive-type boiler, generating steam at 450 lb. per sq. in. The engine was designed as a four-cylinder compound, with two stages of expansion. Other super-pressure locomotives have been built in various countries to the Schmidt patents, with boiler systems working at a maximum of 900 to 1,000 lb. pressure. But the designers have had to discover by experience that principles which may operate successfully with a stationary steam power plant are by no means so easy to apply to a locomotive, which is subject to considerable vibration in running. In particular, keeping steam-joints tight in service when subjected to pressures up to 1,000 lb. per sq. in. proved almost impossible, and none of these designs had any ultimate success.

In the period from 1935 to 1937, with the introduction of streamlined trains required to cover considerable distances at the 90 m.p.h. level of speed, British locomotive designers turned their attention to streamlining, in an endeavour to cut down coal consumption at these speeds by reducing head-end resistance.

Experiments with the Gresley 'A4' Pacifics on the 'Silver Jubilee' showed that these engines could run the train at an average power output lower by roughly 100 h.p. than the previous non-streamlined 'A3' Pacifics, which meant an average reduction of 4 lb. per mile in coal consumption, though certain improvements in the design of the 'A4s' helped to account for this increased efficiency. Apart from the locomotive comparison, however, the maximum contribution to reducing air resistance was probably due to the streamlining of the trains themselves, with their windows flush with the coach panels, rubber inserts joining the coach-ends—to provide a smooth surface from end to end of each train—and valances extending downwards between the bogies.

But in the post-war years the imperative necessity to cut maintenance costs to the minimum has become of more importance than any slight gain in efficiency due to streamlining. As streamline casings interfere with inspection and maintenance, therefore, the London Midland Region has removed these entirely from its former streamlined Pacifics, and the same process is now being carried out in the rebuilding of the Bulleid Pacifics of the Southern Region. In passing, it is worthy of note that all the highest British speed records of the past have been achieved by streamlined locomotives, up to the 43 miles at 100 m.p.h. continuously maintained by the L.N.E.R. Pacific 'Silver Link' in 1935, the maximum of 113 m.p.h. reached by the same company's 'Silver Fox' in 1936 and of 114 m.p.h. by the L.M.S.R. 'Coronation' in 1937, and the 126 m.p.h.—a world record for steam—of the L.N.E.R. 'Mallard' in 1938. The last-mentioned feat was assisted by the engine's double blast-pipe and chimney, which both improved the draught and gave a freer passage to the exhaust.

In striking contrast to the streamlining activities of the past is the present tendency to mount more and more of the steam locomotive parts outside the locomotive, where they are more easily accessible for inspection and repair, thus shortening the time spent by the locomotive in the shops and increasing its availability for service. In this connection also a major disadvantage of steam traction is the periods during the locomotive's day during which it must stand idle, between runs, while the firebox is cleaned of clinker and locomotive requirements are attended to—a disavdantage in which fuel plays a part.

Finally, there is a factor, also connected with fuel, which has had more influence than almost any other in compelling the decision to end steam traction. It is the increasing difficulty of recruiting labour for manning and maintaining steam locomotives. Hitherto the only way of approach to locomotive driving has been, first, cleaning at the locomotive sheds and, second, firing; and both may occupy years before promotion to driving takes place. Because of the use of coal, cleaning is dirty work and firing is laborious. With so much other employment available, in comfortable shops, with regular hours, and not infrequently higher wages also, it is hardly surprising that work on steam locomotives no longer attracts to the extent that it once did. Shortage of shed staffs often results in cleaning going by default, as the external condition of many locomotives only too unhappily bears witness; firing also may begin at an unduly early age, with indifferent steaming and loss of time by the locomotive as a result.

The factors on which the decision for the abandonment of steam traction has been based may therefore be summarized as follows:

(1) The limit of development in size and power has been reached.
(2) By reason of its low overall thermal efficiency, the steam locomotive does not make efficient use of coal.
(3) The best qualities of large, hard coal are no longer available in bulk for locomotive use, so that steaming is often affected adversely.
(4) There is increasing difficulty in recruiting labour for steam locomotive manning and maintenance.
(5) The emission of smoke contravenes modern smokeless-zone ordinances.
(6) For reasons (3) and (4) the observance of schedule times by steam locomotives has become more uncertain than in former years; and as loss of time by a single train may affect the working of many others, the general standard of punctuality has been progressively lowered.

The aim of the modernization plan is radically to change this state of affairs; and the logical development, in a country with ample coal resources, is electrification. In Switzerland, with no indigenous coal but vast resources of water power, the availability of relatively cheap current produced in hydro-electric power-stations has long since caused the abandonment of steam in favour of electric traction, now applied to some 95 per cent of Swiss railway working. In such mountainous conditions as those of Switzerland, also, with long and steep gradients, electrification has made possible, with the introduction of locomotives of up to 6,000 h.p. apiece, the working of increased loads at considerably higher speeds than formerly, both passenger and freight. Britain has no hydro-electric resources on a comparable scale, but until such time as electricity produced in atomic power-stations becomes widely available, the supply of current from coal-fired power-stations is steadily on the increase. Moreover, the power-plants of these stations can show a considerably higher efficiency than any steam locomotive, even when the boilers are burning slack on which no locomotive would be able to steam properly.

Since the beginning of the present century we have become accustomed to electric traction on suburban lines round and under large cities here and abroad. Also when the former Southern Railway, with commendable enterprise, extended its London suburban electrification down to the South Coast in the years from 1932 to 1938, this was done exclusively in the interests of passenger traffic; not until 1951–4, with the inauguration of electric working between Sheffield and Manchester, had we in Great Britain a main line electrified primarily to improve heavy freight working over steep gradients. Here the operation has been transformed, considerably fewer locomotives being now able to handle heavier loads at much higher speeds than hitherto; by reason of the higher speeds, the headway between trains has been reduced and potential frequency of service increased accordingly. The 1955 British Transport Commission modernization plan now envisages the first long-distance main line electrifications in Great Britain, having selected for the purpose the two main lines which carry the most intensive traffic, both passenger and freight. They are the London Midland

Region line from Euston to Liverpool and Manchester, with the Rugby-Birmingham-Stafford loop, and the Eastern Region main line from King's Cross to Doncaster, Leeds and York.

As regards the future type of electrification in Great Britain, the British Transport Commission has had to make a difficult decision. Most early railway electrification experience in this country has been with direct current, picked up from a third rail, and returned either through an independent fourth rail, or through the running rails, which oppose greater resistance. From the reliability and the maintenance points of view this is the most robust type of electrification, but the heavy tonnage of steel that it is necessary to lay down in the form of conductor rails helps to make it the most expensive to instal. Moreover, the current potential with this method is limited to about 750 volts, so that the sub-stations feeding current to the track must be at close intervals, say 5 to 7 miles apart.

In 1932, however, the Minister of Transport made a Standardization of Electrification Order, based on the findings of a committee under the chairmanship of Sir John Pringle, that except for extensions of existing conductor rail systems, future British railway electrification should be entirely with overhead conductors carrying 1,500 volts d.c. After the war this decision was confirmed in 1948 by a further joint committee of the British Transport Commission and London Transport. This system had been introduced previously in 1916 by the former North Eastern Railway, on its Middlesbrough-Shildon electrification, since abandoned; it was and is still in operation on the Manchester, South Junction & Altrincham line, electrified in 1931; and it was used in the first post-war electrifications carried out by British Railways, from Liverpool Street to Shenfield, inaugurated in 1949, and from Sheffield to Manchester, completed between 1951 and 1954.

As far back as 1908 and 1909, however, the earliest experiments had been made in this country with overhead alternating current electrification, by the Midland Railway between Lancaster and Heysham, and by the London, Brighton & South Coast Railway over a considerable part of its London suburban area, both using 6,600-volt current, 50 cycles. In the case of the Brighton line, this showed considerable foresight; but with the formation of the Southern Railway in 1923, the fact that the Brighton overhead system prevented any interworking of stock with the former London & South Western and South Eastern & Chatham electrified lines, both 660-volt third-rail systems, made it essential to convert the Brighton electrification to correspond. Since then the 10 miles of the Lancaster-Heysham line have remained the only a.c. electrification in Great Britain.

In other countries, however, high tension a.c. electrification has come into extensive use, with line voltages as high as 15,000 in Switzerland, Austria, Western Germany, Norway and Sweden. Such voltages with alternating current necessitate both transformation on the locomotives to suitable voltages for the traction motors, and generally, also, rectification of alternating to direct current, as the motors most suitable for railway traction are of the d.c. type. Formerly

this rectification added considerably to the weight and bulk of the locomotives, but modern methods, such as mercury arc and germanium rectifiers, have made possible such compactness of arrangement that with modern locomotives, using high tension a.c., power outputs of the order of 50 h.p. to each ton of locomotive weight are becoming common. A major advantage of such high potential, of course, is that lighter copper conductors can be used, with a lighter catenary construction to carry them, and that far fewer sub-stations are needed than with d.c. electrification.

But the British Transport Commission's decision goes further than this; it has been prompted by the latest electrification development in France. After an experimental installation between Aix-les-Bains and La Roche-sur-Foron in Savoy, brought into use in 1950, the French National Railways decided that their future electrification would be no longer at their previous standard of 1,500 volts d.c., but at 25,000 volts a.c., 50 cycles, using current fed to the conductors direct from the commercial supply. Since then the important passenger and freight route from Lille through Valenciennes to Thionville, Metz, Strasbourg and Basle, with branches of a total length of over 700 route miles, has been electrified on this system, and the results have been completely successful. After a brief experiment on the Lancaster-Heysham line, converted from its previous 6,600-volt a.c. electrification, the British Transport Commission has decided to apply this system to the two major schemes of main line electrification already mentioned, out of Euston and King's Cross respectively.

One reason why this decision has involved a good deal of courage is the enormous amount of engineering work that it will entail. Due to the necessity for maintaining a minimum of 11 in. between the 25,000-volt conductors and all earthed structures (in addition to the distance between the conductors and the locomotive and coach roofs), no fewer than 701 out of the 904 overbridges on the London Midland route alone fail to give the necessary clearance, and require rebuilding or, in certain cases, other expedients such as track lowering. Had 1,500-volt d.c. electrification been decided on, a 4 in. clearance would have been adequate, and the number would have been reduced to 478. The London suburban area presents a special problem, because of the frequency of overline bridges, and so do tunnels; here the potential is to be reduced to 6,600 volts, for which it is hoped that 4 in. clearance may prove adequate. Provision will be made in the locomotives for working on both voltages as required, which presents no serious technical problem. Expense also will be incurred in transferring telegraph and telephone wires, and electric signalling cables, which run parallel to the railway tracks, to underground locations, in order to avoid induction effects from the 25,000-volt conductors.

Careful estimates show that, as compared with 1,500-volt d.c. overhead electrification, the 25,000-volt plan will economize in the cost of power supply equipment, of sub-stations (which can be as much as 70 miles apart), and of feeder cables. On the main lines scheduled for electrification alone some 27,000 tons of copper and 16,000 tons of steel will be saved by the use of a smaller cross-section of conductor wire and a lighter catenary structure. Also, although

in the initial stages the motive power units will be more costly, with bulk production this difference should disappear, and there will be advantages in the use of lighter locomotives, with easier control and better adhesion. The saving in the cost of current and the maintenance of fixed equipment is estimated at £1,000,000 annually.

Even with the increase in the number of bridge rebuildings, a reduction of 7 per cent in the capital outlay on these two main lines is expected from the choice of 25,000-volt electrification, but the additional engineering work inevitably postpones the completion of the conversion, which in the case of the London Midland main line is not anticipated until 1968, and in that of the Eastern Region until 1970. Certain engineering tasks are common to either system of electrification, however, if the maximum benefits are to be obtained. Prominent among these is the substitution of flying or burrowing connections for junctions where at present the trains cross one another's paths on the flat, such as Bletchley and the north end of Rugby on the London Midland Region and the approach to King's Cross on the Eastern Region. It should be added that in the interests of interchangeable stock working, extensions in Kent of the Southern Region electrification are being carried out on the existing 660-volt d.c. third-rail system; but the 1,500-volt d.c. Eastern Region overhead system out of Liverpool Street will be converted to 6,600 volts a.c., to conform with the 6,600-volt electrification work now under construction out of that terminus.

The advantages of electric over steam traction may be summarized thus:

(1) Exact predictability of operation, making possible a high standard of timekeeping.

(2) Except on the longer and faster runs, single motormen in place of two-men engine-crews, so economizing in labour.

(3) Far more comfortable driving conditions, in clean, smooth-riding, soundproof and draught-proof cabs, so that the manning of locomotives once again can offer an attraction to entrants to the service. The same applies to maintenance, which is in much cleaner conditions.

(4) Absence of smoke, which greatly assists in keeping rolling stock clean, and also is in conformity with modern smoke-abatement ordinances.

(5) No use of fuel when locomotives are standing; immediate readiness for service without time and labour in lighting up and raising steam; no intervals during daily running for cleaning fires.

(6) Multiple-uint working, permitting power to be proportioned to load, and heavier loads to be handled by double-heading without any increase in engine-crews.

(7) A considerable increase in power output per ton of engine weight, which is of advantage to track maintenance, though partially offset by smaller driving wheels and non-springborne axle-loading.

(8) More rapid acceleration from rest; higher continuous tractive effort; unlimited capacity of suitable types for sustained high speed.

An advantage shared with steam traction, in British conditions, is the use of indigenous fuel for power production, whether in coal-fired or atomic power-stations. The major disadvantages of electric as compared with steam traction are: first, the extremely high cost of electrification; second, that electric motive-power units (apart from battery-fed railcars, which have a limited range of action only) are confined to electrically-equipped tracks; and, third, that current failures, even with the resources of the grid system of distribution, can bring traffic to a complete standstill over a wide area.

We come, finally, to the second substitute for steam that figures in the British Transport Commission's modernization plan, and this is diesel power. While diesel traction already is in extensive use in many countries, Great Britain included, it is in the United States that it has made the greatest strides; in that country 90 per cent of all railway traffic, passenger, freight and shunting alike, is now diesel-operated. Never before in railway history, probably, has a revolution in railway traction on so great a scale taken place in so short a time as in the U.S.A., mainly, indeed, since the 1939–45 war. It has been due in the first instance to the foresight of the General Motors Corporation, which, before there was any widespread demand, had created its Electro-Motive subsidiary to design, manufacture and market diesel-electric locomotives exclusively. So energetic was its salesmanship that it has built by far the major proportion of United States diesel locomotives; also, as U.S.A. railways had the wisdom to accept the standard designs of this and the other one or two makers, mass production has been possible, cost has been kept to a reasonable figure, and parts storage has been reduced to a minimum.

Two other factors, however, have strongly influenced the change-over in the U.S.A. from steam to diesel traction. One is the length of continuous run over which it is possible to work a diesel locomotive without change, as, for example, the 39½-hour 2,226-mile journeys of the Santa Fe streamline trains between Chicago and the Pacific Coast, to take an extreme case. The other is that the United States has indigenous oil as well as coal. In Great Britain, on the other hand, diesel locomotives must depend on imported fuel. Also, in a country like ours, with relatively short distances, it is not generally possible in ordinary passenger and freight service to keep diesel power so continuously occupied, though such assignments as the 803-mile round trip from Euston to Glasgow and back involve a substantially greater mileage in the 24 hours than is normally expected of steam. In shunting and marshalling yards, however, it is another matter, and the hundreds of diesel shunters which already have displaced steam shunters are making possible considerable economies by their ability to work round the clock if necessary, as well as needing no time off during their daily duties to take water, or to clean their fires of clinker.

Apart from the eventual taking over of all shunting and marshalling work, the future purpose of diesel traction in the modernization plan is twofold. On the main lines scheduled for electrification, on which the preparatory work, as we have seen, cannot be completed until some years hence, the diesels will act as a kind of half-way house between steam and electric traction. As to other

main lines, some will doubtless be electrified in due course, but with others, carrying lighter traffic, the prospect is more remote; in either case the gradual replacement of steam power by diesels will result in a more permanent use of the latter. Then there are the diesel train sets, with self-contained power, which have taken over the entire branch working in large areas of the country, and with their attractive interiors, cleanliness, higher speed and even-interval running times have proved so popular with the travelling public as nearly to double the passenger traffic on some lines; these may also be regarded as a permanency in areas where the extent of traffic would not justify the high cost of electrification. In the Leeds, Bradford and Harrogate area the passenger patronage has quintupled in the five years during which the diesel sets have been in use. Moreover, in the North Eastern Region alone diesel multiple-unit trains are estimated to be cutting working expenses by all but £900,000 annually. Certain of the smaller branch lines may be saved from closure by the latest four-wheel diesel rail-buses, which are extremely economical to run, though they have the disadvantage of being inflexible in carrying capacity, as their engines are not powerful enough to haul trailer vehicles.

Against diesel power is the high cost of the motive power units. Here the extreme is represented by the English Electric 'Deltic', which is valued at £200,000; against this must be set its high h.p. rating of 3,300, the highest in the world yet incorporated in any single diesel locomotive unit. In part the high cost of all diesel locomotives in the United States and most of those in Great Britain is due to their electric transmissions, which add the substantial bulk and weight of electric generators, traction motors and control gear to that of the diesel engines proper. In Germany, however, hydraulic transmissions have been perfected which are capable of handling up to 2,000 h.p. successfully, and this is the method now under trial in the new diesel-hydraulic locomotives of the Western Region. The Swindon-built examples, of the Bo-Bo type, weigh only 78 tons for a maximum horsepower output of 2,200, whereas a typical British diesel-electric model, such as the English Electric 1 Co-Co 1 type now at work on the Eastern Region, is rated at 2,000 h.p. and weighs 133 tons. However, the 'Deltic', with its unique diesel cylinder arrangement, weighs no more than 106 tons for its output of 3,300 h.p., so there are possibilities of weight reduction in diesel-electric units also. The self-contained diesel train sets are of such low power that it suffices to fit them with simple mechanical transmissions, with certain refinements.

As compared with steam, diesel traction shares all the advantages already enumerated for electric traction. At present fuel prices its fuel costs are roughly half, or slightly less than half, those of steam traction, but as soon as the newness has worn off, the maintenance costs of the complicated diesel-electric power-plants are likely to be fairly high. The diesel, being a self-contained power-plant, shares with steam the ability to travel anywhere, not being restricted, like the electric locomotive, to electrically-equipped lines. Nevertheless, the high cost of diesel locomotives can be justified only if their continuous availability is put to the maximum possible use. This high capital cost might have been reduced

in Great Britain had pressure been put on the many different firms which are now supplying diesel locomotives and train sets to British Railways to form a consortium with a view to producing a range of standard designs to which all would have conformed. This would have greatly reduced the number and variety of types now coming into service, and might, as in the United States, have made possible mass production on an extensive scale.

There are many other aspects of railway operation in which the modernization plan of the British Transport Commission foreshadows revolutionary changes, some coming into being already, but limits of time forbid the author to deal with them in this paper. He trusts that sufficient may have been said, however, to show that in the highly important realm of motive power the decisions that have been taken, and are now being implemented, will assist in making possible the more efficient, speedy and economical railway working to which we all look forward.

DISCUSSION

MR. HUMPHREY BAKER: I gather that our new methods of operation will enable us to provide quicker and more frequent services, and very often they will *have* to provide more frequent services if they are to justify their first cost. I have been distressed lately by the way in which, when a branch line or even a secondary major line does not seem to be attracting enough traffic, the Transport Commission either closes stations or closes the line itself—in other words the Commission seems to despair and throw in the sponge. I feel that the great faults of our present railway transport system are low speed and infrequency. To take my own recent experience: I have been spending several months at Bath, a place very well served by trains to and from London, which I have to visit for various meetings. From Bath I have had also to visit various places not so very far away, such as Gloucester, Cheltenham, Taunton, Minehead, Salisbury. They are all within a moderate distance by rail of Bath itself, and when I have to go to any of them I prefer to do so by train because it is more restful than driving my own car. But I find that in every case the train is slower than my car would be—and I am not a speed-fiend. And that is without taking into account the time it takes to get *to* the station at the starting end and the time *from* it at the other end. Furthermore, the trains generally run at inconvenient times.

Now I do not see how the railways can expect to compete with the roads unless they give a more frequent and faster service than at present, and I do hope that our modernization of equipment will result in such services all over the country—not merely on the main lines to and from London.

THE LECTURER: This seems to carry us a considerable distance beyond the precise subject matter of the paper. I have been trying to deal with the technical aspects of motive power rather than such questions as timetables. I think, however, you will see in East Anglia from the beginning of January a sort of pattern for the future. There will be an express train to Liverpool Street from Norwich at 30 minutes past each hour, with systematically-timed services in other directions, including connecting branch services, all diesel-operated. The Southern Region has had such even-interval services, both electric and steam, for a long time past. Eventually through modernizing and electrification even-interval services will be general, and there will certainly be very greatly increased speeds. The B.T.C. is aiming at a maximum speed of 100 miles per hour with passenger trains on the main lines, and 60 miles per hour with freight trains, so that the entire train service ultimately is likely to benefit, although you may have to wait some time before these aims are realized.

At the same time I will say that if the train services were to be so framed as to suit everybody's convenience, individuals as well as the people in the mass, trains would need to stop at almost every station on their journeys, and might well need to travel at 500 miles per hour or so between stations in order to maintain any respectable overall speed! We must consider the economics of these things, and also the convenience of the majority, in framing railway time tables.

MR. G. VIVIAN DAVIES: I think it is a fact, Mr. Chairman, that the average speed on our railways now is less than it was some thirty or fourty years ago. I remember once travelling from Newcastle, when the train was half an hour late there, but made up this time and actually arrived at King's Cross punctually. A few of us went to congratulate the engine driver—this was such an unusual experience. He just looked at us and said, 'Take a look at the plaque on the engine'. It was the 'Martin', which holds the world's speed record (I think it is still the world's speed record) of 138 miles an hour on the famous run to Bristol. So, of course, there was no more comment required. I wonder whether any diesel will put up such a performance, and whether the speaker can tell us if any great difficulty is anticipated in maintaining diesels. I remember asking Mr. den Hollander the same question here when he read a paper to the Society some time ago. I expected a quick reply, but I think he spent ten minutes detailing the many difficulties experienced. I will not expect our speaker to do the same!

Now on the question of comfort: I went up to Calder Hall recently with some very important foreign engineers. We went by the usual route, which is a sleeping coach up to Seascale *via* Barrow, and when we got to the last part of the route—whether it was because the engine driver was inexperienced or whether the brakes were inadequate on this particular sleeper I do not know, but every time the train stopped we felt repeated shocks and the foreign visitors were thrown out of bed. It does seem to me that the British Railways might put on some better facilities on this route.

Lastly, I should like to ask our speaker whether the railways have done anything to improve the handling of goods in and out of goods vans and luggage vans on passenger trains, because it does seem to me that there is an unnecessary amount of hulking by hand and the use of sheer physical force which could be avoided by means of simple mechanical aids.

THE LECTURER: I venture first of all to correct the speaker. The engine which created the record was 'Mallard', and not 'Martin'. The maximum speed was 126 miles an hour and not 138, and it was also achieved between Grantham and Peterborough and not between London and Bristol. It is perfectly true that we had before the war streamlined trains which ran to Newcastle in four hours, to Edinburgh in six hours, and elsewhere. These were outstanding performances. But I think it is probably true to say that on certain of our main lines to-day, for example in East Anglia and up the East Coast main line between King's Cross, York and Newcastle, the average speeds of all express trains together are higher than they were in 1938. Over the Western Region main lines from Paddington to Bristol and the West the general average of speed is no lower to-day than in 1939, but other main lines, such as that out of Euston, are harassed by restrictions arising from the work being done in connection with electrification. At any rate, we are in an intermediate stage at the moment and as we are still working mainly with steam, we cannot expect as yet the high sustained speeds which are certainly intended as a result of the present modernization plans. As regards the individual sleeping car to which reference was made, I am afraid I do not know its characteristics and I cannot explain its behaviour —there are black sheep in every flock and in this respect the railways are not exempt.

MR. L. J. GRIFFIN: I have recently been travelling between Hastings and London, and I have not suffered such a rough ride since the days of cobbles! The

suspension, right from the wheels on the rail to the poor upholstery, is really atrocious. I am not connected with the railways; I am a designer in other fields; but I do feel that even though these are interim trains (from the outside they look as if they were built about thirty years ago) they should be provided with a much higher standard of general comfort. Trying to read a newspaper in a train in the London area is very much like trying to read in a bus; you get joggling and a very hard and rough ride. The train compartments are also very narrow and skimpy, but I believe that is due to narrow tunnels. Could I have the lecturer's comments on why this new type of diesel train involves such uncomfortable conditions?

THE LECTURER: Certain troubles on the Hastings service with the new diesel-electric trains were unavoidable. Because of two or three narrow tunnels on the route the stock has had to be built within those restrictions; otherwise it would have been necessary to open those tunnels out to daylight at very considerable expense. I do not in the least agree with the speaker as to the comfort of the new Hastings stock, which to my mind has every reasonable amenity. As to rough riding, where you have a multiple-unit train which is being pushed as well as pulled by the traction motors, the riding is generally less smooth than when the whole of the traction is from the head end. There has been trouble with the bogies of some of the latest British Railways standard diesel and electric stock, but it has been the subject of careful investigation, and—I speak for the new suburban electric trains on the Euston and Watford line—they have been greatly improved in riding by the modifications which have since been made to them. I am not in the counsels of the B.T.C., and speak as a private individual; but I do know that serious complaints are taken seriously, and that no stone is left unturned in investigating such complaints and endeavouring to correct deficiencies.

MR. E. J. WIDDICOMBE: Mr. Allen mentioned the cost of the 'Deltic' locomotive. I wonder if he would repeat that cost and also let us know what, in his opinion, would be the cost of comparable steam locomotion made in British Railways' own workshops to-day. If, for instance, it would require two engines to give the same power, what would be the capital cost? Also, does Mr. Allen consider that there has been too much dieselization planned without thorough knowledge of the long-term maintenance charges? I am given to understand from the technical Press that only now are the authorities controlling the King's Cross-Grantham run in possession of sufficient units to begin to assess the real economy of diesels on long-distance express service.

There is a question I would ask about the Hastings multiple-unit diesel-electric services. Has Mr. Allen stood on Warrior Square Station and noticed the drift of fumes from either tunnel? I believe this is a subject of dire complaint by Hastings people. It seems a great pity that an otherwise almost wholly electrified passenger coastal service from Portsmouth to Hastings has had to be 'mixed', over a section of the route, with diesel services which are obnoxious to many people.

THE LECTURER: First of all with regard to the £200,000 estimated cost of the 3,300 h.p. 'Deltic'. It is very difficult to make any precise comparison with steam. The continuous power output of the 'Deltic' cannot be exerted by any type of steam locomotive that we have in existence in the country to-day. Maximum power outputs in the 3,000 h.p. range have been recorded with a 'Duchess' class Pacific locomotive of the London Midland Region, but for momentary periods only. At an extremely rough estimate, I should say that two steam locomotives capable of the same continuous output as the 'Deltic' would probably cost £100,000 or so at the present prices. With regard to the speed at which dieselization is being carried out, the British Transport Commission as I see it has been in a position of great difficulty. Some decisions had to be taken at once. Only this week we have heard of further demands from the Government for railway economies, as an offset to the fall in revenue, and these cannot be achieved while steam power is still in use. It was certainly the intention of the B.T.C. to conduct extended trials of many different

makes of diesel before the final decisions were made, but so urgent has been the need for economy that very large orders have had to be placed straightaway. For this reason it has been almost impossible to make the extended investigation that the last speaker considered the British Transport Commission should make.

As regards diesel fumes, I have travelled on the Hastings diesel-electric trains and I cannot imagine that the fumes from them are any worse than those given off daily by hundreds of London buses. There is far more diesel traction on the roads to-day than on the whole of the railways, so I do not think that the railways are responsible for any particularly lethal conditions in the country from this cause.

MR. JOHN H. WHITAKER, J.P.: As a layman I should like to congratulate the lecturer on his very able address. It has been most interesting and I have thoroughly enjoyed it.

I have two questions. My first bears on the cost of electrification. Is Mr. Allen certain that enough can be saved from the difference in cost between the purchasing and burning of coal and the paying for electrical energy to meet the interest and depreciation charges on the cost of electrification? Because if enough cannot be saved, then there is no advantage except that you might attract some more passengers, and of course that is what you are trying to do. I can quite understand Mr. Baker's complaints, but I know it just is not possible to provide a service at the right time for everybody who requires to travel. That is one of the difficulties.

Another point, raised by Mr. Vivian Davies, was the question of speed. I think he said that the express trains were running less fast to-day than they were in 1938. Well, before the war the train used to start from London Road, Manchester, at 5.45 p.m., and it used to arrive at Euston at 9 o'clock as regularly as clockwork. Three hours and a quarter. Is there anything to approach that to-day on an express service?

THE LECTURER: To answer the last question first, I think I did mention the very considerable difficulties under which those which are to be electrified travel due to the work that is proceeding on the track. It is true that the 'Comet' used to come up in three-and-a-quarter hours, so did the 'Lancastrian' in the morning. Now roughly twenty minutes have been added to the schedules of all the London Midland Region expresses to allow for the permanent way restrictions that they will encounter while electrification is proceeding. But I have referred already to the comparison between past and present railway speed in Great Britain, and it is by no means to the discredit of 1958. For example, the general standard of running on the Eastern Region to and from King's Cross (and here I speak as one who has used that line for the last fifty years regularly) with the sole exception of the streamline services from 1935 to 1939 is the fastest that I have ever known. Maximum speeds of 90 miles an hour and over are now quite common. As regards the other point mentioned by the speaker, I cannot give all the facts and figures and arguments in this connection, but the British Transport Commission are hardly so devoid of common sense as to initiate this tremendous change without having gone exhaustively into the economics of the matter, both short-term and long-term. Moreover, for reasons that I have explained, it is no longer possible to stick to steam traction; above all, if you do, how are you going to provide the labour to man and maintain the locomotives? To my mind the decisions to which the British Transport Commission have come have been completely inescapable.

THE CHAIRMAN: Our railways are absolutely vital to our industry and commerce, and I feel, having listened to Mr. Allen this afternoon, that the planning skill and the ability of our railway engineers and our railway management are impressive. I should like to feel that at such a meeting as this we can wish all those now engaged on this immense programme of work which is to be achieved on our railways the utmost success. It is now my very pleasant duty to thank Mr. Allen for a delightfully lucid and informative lecture.

The vote of thanks to the Lecturer was carried with acclamation, and the meeting then ended.

IMPROVING THE EFFICIENCY OF THE MINING INDUSTRY

The Cadman Memorial Lecture by

H. A. LONGDEN, B.Sc., A.M.I.C.E., F.G.S.,

Director-General of Production, National Coal Board, and President, Institution of Mining Engineers, delivered to the Society on Wednesday, 19th November, 1958, with Sir James Bowman, K.B.E., J.P., Chairman, National Coal Board, in the Chair

THE CHAIRMAN: May I say how honoured I am to be invited to preside at the seventh Cadman Memorial Lecture to-day. The first Lord Cadman was associated with what has become something of a competitor with coal, the oil industry, but he was also, as we all know, a very notable mining engineer of his day and also an outstanding figure in the coal industry for a great many years. He was at one time President of the Institution of Mining Engineers, the position which is currently held by our lecturer.

This series of Cadman Memorial Lectures is a tribute to Lord Cadman's memory and his great contribution to the mining industry and to his lifelong interest in improving it in every way. I think it is therefore especially appropriate that this afternoon's lecture should deal with what is to-day (as it was in Lord Cadman's day) the fundamental task of any industry: that of improving efficiency. And when I say that this requirement is of supreme importance, I am thinking not so much of the short or medium term aspects of the present extremely difficult situation through which our industry is passing and which I think can be attributed mainly to the present industrial recession. There can be no doubt that the coal industry must continue to be the major supplier of energy in this country for a long time ahead, but I think there is one factor in the changed circumstances about which we must all be clear: that alternative fuels at attractive prices will continue to invade what we have regarded as our market, and to take away what we have regarded as valuable consumers, unless the mining industry can recover and surpass the impetus towards increased productivity which it experienced during the first five years after nationalization. This means, gentlemen, efficiency on every side of its operation, in the effective use of up-to-date equipment, the latest managerial and scientific techniques and the deployment of manpower.

Mr. Longden's entire working life has been spent in the cause of progress and efficiency in the mining industry. He comes, indeed, from a family with a traditional connection with the mining industry going back into the eighteenth century, and I think it is correct to say that his is the fifth generation of his family to be associated with mining. The association of the Longden family therefore covers virtually the whole of the period of great expansion in the mining industry which occurred both during and following the Industrial Revolution. Mr. Longden is a native of Nottinghamshire, but he has, I hear, the distinction of having played Rugby for Yorkshire, and it was in Yorkshire that he worked until 1955, when he was appointed Director-General of Production at the London Headquarters. He worked with very great success in various capacities involving the East Midlands and Yorkshire coalfields before nationalization, and between 1947 and 1955 he gave outstanding and valuable service, first in his capacity as an Area General Manager and later as Production Director for the North-Eastern Division. Mr. Longden came to London

to play a most important part in the drive, which began in 1955, to bring about the most rapid and effective increase in the use of methods for the combined, mechanized cutting and loading of coal at the coal face. As Executive Head of the Department responsible for undertaking this task he deserves considerable personal praise for having overcome—almost in his stride—the enormous problems which he had to face in the initial stages of that drive. It will indicate the size of the operation which he has carried out if I mention that during 1955 the percentage of the total output of coal which was won by mechanized methods was just over 10 per cent. Currently, it is about 30 per cent. At the moment about one thousand power-loading machines are operating in the collieries of Great Britain. Much progress has been made already in this and other modern methods of efficient mining, but a great deal more needs to be done, both in extending modern methods and of course in the ceaseless task of improving our existing methods. No more important subject could have been chosen for this lecture, and no one more suitable to deal with it than Mr. Longden.

The following lecture, which was illustrated with lantern slides and models, was then delivered.

THE LECTURE

INTRODUCTION

I feel it is a great honour to be invited to give this, the seventh Cadman Memorial Lecture. I was one of the very fortunate people who, as a young man, met Sir John Cadman, as he then was, at a time when he was engaged in the search for oil in this country. It so happens that the Eakring Field, the only really successful field in this country to date, lay on the eastern fringe of the 'take' of a Colliery Company with which I was then associated. My recollection of him is, above all else, of the very kind way in which he treated me as a very junior executive. There is no doubt that as a result of his long experience in the educational field he recognized my shortcomings without making them obvious to one and all.

ECONOMIC BACKGROUND

I have taken as my title for this lecture 'Improving the Efficiency of the Mining Industry', and at the outset I should like to explain its relationship to two earlier lectures in the series which bear on the same subject. In 1949, Sir Charles Reid and Dr. William Reid gave a picture of the post-war reconstruction of the mining industry and then, in 1953, Mr. Humphrey Browne spoke about some of the measures being taken, or needed, to improve coal production. Both lectures were set against the common background of a situation in which the demand for coal far exceeded the supply and in which, therefore, the first concern was to expand the bulk output of the industry. As you may well know, the background situation to-day is somewhat different.

The Present Recession

The future estimates of demand on which planning has been based, were that there would be a ready sale for 228 million tons of coal in 1960 and for 240 million tons in 1965, of which deep-mined production would contribute 216 and 228 million tons, respectively.* Since deep-mined production in 1948

* N.C.B., *Plan for Coal*, d. October, 1950 and *Investing in Coal*, d. April, 1956. Other Great Britain statistics used in this paper are taken in the main from the Ministry of Power *Statistical Digest for 1957*, the remainder from N.C.B. sources. American statistics are taken from *Bituminous Coal Data*, 1957, published by the National Coal Association, Washington, D.C.

amounted to no more than 198 million tons, a considerable effort of expansion was clearly needed.

In fact, until recently, there has been every reason for confidence in these early estimates. Ever since the war, industrial production had increased at an average rate of about 4 per cent per annum with a corresponding expansion in the demand for fuel which averaged 2½ per cent per annum. Every ton of indigenous coal was needed and in some years coal had to be imported, so that even as late as 1955 no less than 11½ million tons were bought from America and Europe.

By 1956, deep-mined production amounted to 210 million tons, and although there were signs of a slowing down in industrial expansion there seemed to be no reason to expect any lessening of the demand for coal in 1957, particularly in view of the Suez crisis which developed at the end of 1956. In the event, however, home consumption of coal fell by 5 million tons in 1957 and has fallen at a still faster rate in 1958, so that it is expected that home consumption this year will prove to be some 16 million tons below the 1956 level.

Recent Trends in the Main Coal Markets

The coal market is dependent on the amount of coal used by a number of different industries and it may be interesting and instructive to consider recent individual trends in the main categories of consumption. The following table covers the period from 1947–57:

DISPOSAL OF AVAILABLE COAL SUPPLIES (INCLUDING OPENCAST AND IMPORTED) 1947–1957

	1947 *million tons*	1956 *million tons*	1957 *million tons*	1957 *compared with* 1947 *% increase or decrease*
1. Gas Industry	22·7	27·8	26·4*	+ 16%
2. Electricity Industry ...	27·1	45·6	46·5	+ 72%
3. Railways	14·6	12·1	11·4	− 22%
4. Coke Ovens	19·8	29·3	30·7	+ 55%
5. Industrial Consumers				
(i) Iron and Steel ...	8·7	6·1	5·6	− 36%
(ii) Other Industries ...	31·4	33·3	31·9	+ 2%
6. Domestic Market ...	36·6	37·1	35·1*	− 4%
7. Other Inland	21·3	24·1	22·6	+ 6%
TOTAL INLAND ...	182·2	215·4	210·2	+ 10%
8. Exports and Bunkers ...	8·0	12·7	10·9	+ 36%
TOTAL INLAND AND EXPORTS	190·2	228·1	221·1	+ 11%

*The winter was exceptionally mild.

It will be seen that the increases in demand are for gas-making, electricity and coke ovens, and for all these markets small coals of suitable quality are needed.

The decline in consumption by the gas industry in 1957 was mainly due to the mild winter and to the increased use of electricity and paraffin for domestic heating which has also affected the house coal market. Due in fact to coal rationing and also to a change of taste by the consumer, domestic consumption both of house coal and of gas has remained static for a number of years. It seems probable that both markets have reached their peak and will decline in the future. Industrial consumption of gas, however, is on the increase.

The figures show a large increase in coal consumption for generation of electricity over the last ten years, but the amount of coal sold to power stations during the past eighteen months has not increased in step with the power generated, and this must be attributed partly to the Government's decision in 1954 to switch a number of existing and projected new stations to oil-firing, because of an expected shortage of coal in future years. It is a strange and unfortunate irony of fate that the completion of some of these plants should coincide with mounting pithead stocks of coal. In my opinion, there will be a resurgence of demand in due course, and because the power stations are our biggest single customer I propose to return to this subject later.

The decrease in consumption by the railways over the past ten years is much as expected and reflects the progress of British Railways' programme of dieselization and electrification.

Sales to coke ovens showed a healthy increase until the beginning of this year, when they started to drop owing to the present recession in the iron and steel industry. There is, however, no substitute for coke in the smelting process and we may expect an increased demand for coke when the iron and steel industry picks up again.

We cannot necessarily expect a similar improvement in the demand for coal from general industry. Because of its convenience and present cheapness, and even technical superiority in certain specialized processes in industry, fuel oil has made substantial inroads into the market offered by engineering and general industry, and coal may continue to lose ground in this field.

Finally, a word about exports. In the past this country had a very substantial export market, but since the last war we have been unable, because of the pressure of home demand, to maintain regular supplies to our overseas customers. In consequence, many of them on the Continent have entered into long-term contracts with other suppliers, notably the United States of America, who are at the present time further assisted by very favourable transatlantic freight rates. Poland, too, has lately entered the export market, offering delivered prices which in some cases are below pithead prices in Great Britain, and at the same time the producing countries of Western Europe—Germany, France, Belgium—are now, like ourselves, encountering serious difficulties in disposing of their output. It must, therefore, be some time before we can recapture our foreign markets, and only then if we can guarantee a steady supply over the years at prices which compare favourably with our competitors'. It is also salutary to remember that

even before the last war, when we were selling large tonnages abroad, the coal was virtually all sold at prices lower than those realized in the home market.

Trends in the U.S.A.

I should feel depressed by the picture I have just painted—and no doubt I have managed to depress my present audience—had I not recently had the advantage of studying and discussing with mining men in America the trends in their own coal industry. The first fact that strikes one is that despite the existence of the overpowering American oil industry, coal maintains the lion's share of the market for electrical power generation and has *more* than held its own against oil in the past decade, as the following figures show:

KWH GENERATED PER ANNUM (IN 1,000 MILLION KWH)

Fuel Used	U.S.A.				GREAT BRITAIN			
	Coal	*Oil*	*Natural Gas*	*Total*	*Coal*	*Oil*	*Natural Gas*	*Total*
1947	137	17	23	177	41	·074	Nil	41
1957	346	40	114	501	89	·098	Nil	89

The figures for Great Britain show a similar though less spectacular upward trend and, as one might expect, almost complete dependance on coal. Surely this is encouraging.

In America it is a fact that electricity provides a form of power which is becoming increasingly popular for most purposes. This is confirmed by the annual sales of oil and gas burners and mechanical coal stokers which have reached their peak and are now either static or actually declining. The use of oil and natural gas for electricity generation is mainly confined to those areas where these fuels are readily available and coal is not. In this country coal is always readily available and, in my opinion, there will be an increasing demand for its use.

Another interesting table shows the trends over the ten years 1947–57 in America's main inland coal markets.

CONSUMPTION OF BITUMINOUS COAL IN U.S.A. BY MAIN CATEGORIES 1947–57

	1947	1957
	million short tons	
Electricity Utilities	86	157
Steel Industry (incl. Coking Ovens) ...	119	117
Railways	109	8
Other Industry	132	98
Retail Dealers (Domestic sales) ...	97	38
Stocks (Distributed)	47	80

Leaving aside electricity, which we have already considered, the very marked downward trends in consumption by the railways and the domestic market, particularly the former, are the most striking. The beginnings of similar trends in this country are already apparent, as we have seen.

As is well known, central heating is standard practice in American homes, but there are signs of a trend towards the use of electrically operated heat pumps which have the advantage of providing central heating in winter and air conditioning in summer. Because of our very much more equable climate in this country, it seems very doubtful whether we shall ever copy this system on a large scale or whether the use of coal-burning fires and stoves will decline to quite the same extent as it has done in America.

Consumption by the United States steel industry has remained relatively steady, whilst in other industry it appears that coal is steadily losing ground to other forms of power.

The Future Outlook

Despite certain differences, I venture to suggest that in studying present trends in America we may well be seeing the shape of things to come in this country; and I take heart from the fact that what we may lose in certain markets we have every chance of making good in the expanding field of electrical power generation. At the present time the average domestic consumer in Great Britain consumes only 1617 kWh. annually as compared with the 3138 kWh. taken by his counterpart in America. The use of electricity as a source of power in the home for the variety of labour-saving and recreational appliances now on the market is a field which, in particular, can be very much more fully exploited.

The small foothold which oil has gained in electricity generation is not at present justified on economic grounds. In my view, in the future it will still not be justified because the coal-burning stations need small, uncleaned coal and this is the fuel which, as we shall see later, our modern machines in the pits can produce most cheaply and efficiently.

The Need for Improved Efficiency

It must be stressed that the American coal industry has only held its own in the face of intense competition from indigenous oil by achieving an efficiency of production in terms of output per manshift (O.M.S.) which, making all necessary allowances for our more difficult conditions, has not been matched by our own industry.

The following table compares productivity, earnings and proceeds in the American and British mining industries. Since productivity in Britain rose by not more than 13 per cent over the ten years 1947–57, the industry had little possibility of absorbing the increases in wages which were largely necessitated by inflation, hence the price of coal rose by over 100 per cent. In America, by contrast, productivity rose so much more—some 60 per cent—and inflation of money wages was so much less, that it has been possible to keep necessary increases in coal prices within 25 per cent.

PRODUCTIVITY, EARNINGS AND PROCEEDS

	U.S.A. (1)			GREAT BRITAIN (2)		
	1947	1957	*Increase*	1947	1957	*Increase*
Output per Manshift (long) tons) ...	4·90	7·86	60%	1·09	1·23	13%
Earnings per Manshift ...	$13·12 cts.	$24·16 cts.	84%	27*s.* 8*d.*	57*s.* 2*d.*	107%
Proceeds per long ton ...	$4·66 cts.	$5·71 cts.	23%	40*s.* 3*d.*	82*s.* 1*d.*	104%

NOTES: (1) Earnings and Proceeds refer to all bituminous mines; O.M.S. to deep bituminous mines only.
(2) Figures refer to all deep mines.

There could be no better time to study this problem than the present, when the industry is able to produce more coal than is for the time-being needed, when we have approximately 37 million tons of stocks at the pithead and in consumers' hands, and when oil and paraffin are making perceptible inroads into certain of our markets.

The earlier lecturers to whom I have referred and who covered many of the problems of the mining industry on a very broad front, all emphasized that the rebuilding of the industry and the provision of facilities for getting the coal away from the coalface would be of little value unless real results could be achieved at the face; and since this is the key to efficient production I feel that some account of developments at the coalface will be of interest.

MECHANIZATION AT THE COALFACE

At the turn of the century nearly all the coal produced in this country was won by hand by men with picks and shovels with some assistance from explosives. In those days there was no demand for small coal and it was customary to fill the coal into tubs with a fork, leaving the small coal behind in the pit. Great lengths of coalface were opened out and it was quite usual to have a face half a mile or more in length with stalls or working places every 35 yards having two, three or four men working in them, each stall producing 10 to 20 tons per day. This necessitated enormous lengths of roadway, each carrying relatively small tonnages of coal, haulage to the main collecting places being almost exclusively by ponies.

The Coalcutter

One of the most arduous tasks of the miner was that of undercutting the seam at or near floor-level so that the coal above the cut might be free to drop by

its own weight aided by the strata pressures, or with assistance from explosives or other means of breaking it down. Even quite early in the nineteenth century, therefore, efforts were being made to devise a machine which would do this work. It was not until nearly the end of the century, however, that really successful machines were introduced. The commonest type to-day is the Chain Cutter, which comprises a haulage unit powered by compressed air or electricity and a cutting member consisting of a projecting arm or jib which carries an endless chain armed with small cutting picks. This jib cuts a slot in the coalface of varying depth according to the length of the jib employed, the average being 5 ft.

Although with the introduction of the coalcutter the same long coalface was at first maintained, the coal was cut through much more quickly by machine, that is, the rate of advance of the face was speeded, and after shotfiring only the loading or filling of the prepared coal remained to be done by manual labour. Thus was begun the desirable process of concentrating output with fewer men for a given tonnage of coal and a shorter mileage of haulage roadway to maintain.

The Face Belt Conveyor

In 1906, a further milestone was reached when the first six underground belt conveyors in the world, designed by Richard Sutcliffe, were installed on coalfaces in Glass Houghton Colliery in Yorkshire. The advent of the conveyor, both on the face and in the haulage roads, by speeding up the clearance of the coal made possible a still much higher rate of face advance and led to a further and very significant degree of concentration of the facilities for transporting the coal away to the pit bottom. Faces were reduced in length to match the optimum length of face conveyor, but they advanced much more rapidly and the haulage roads serviced by conveyor could be greatly reduced in number and worked to greatly increased capacity. An idea of the stages of progress is given by the following figures:

Average advance of the face per week by complete hand getting...	say 2 ft.
Average advance of the face per week with coalcutter and hand filling into tubs	say 5 ft.
Average advance of the face per week with coalcutter and hand filling on to conveyors	say 20 ft.

The table on page 41 shows the progress made in installing coalcutters and conveyors and the increase in output per manshift (O.M.S.) which accompanied the process.

By the 1930s the use of the coalcutter was established practice and the use of conveyors was developing rapidly. Once the face conveyor became fully established and recognized as a means of concentrating the coal at a limited number of loading points, engineers conceived the further possibility of producing a machine which would both cut the coal and load it on to the conveyor.

DEEP-MINED OUTPUT IN GREAT BRITAIN—MECHANIZATION AND PRODUCTIVITY

Year	*% of output mechanically cut*	*% of output mechanically conveyed*	*O.M.S. at the face (cwts.)*
1901	1·4	Nil	Not available
1913	8·5	Not available	do.
1923	17·2	do.	45
1933	42·4	30·0	57·2
1943	69·0	66·3	55·0†
1947	74·9	75·3	57·2
1957	87·7	93·8	67·2

† An alteration made in the basis of the statistics in 1943 had the effect of lowering O.M.S. statistically.

The Meco-Moore Cutter Loader

In 1934, the late Matthew Moore, with the backing of the Mining Engineering Co. Ltd., of Worcester, produced a cutter loader which showed some promise. The first machine was installed that year at Chisnall Hall Colliery in Lancashire and others followed at other collieries in the ensuing years. Although two or three of these early machines gave quite good performances, there were certain mechanical weaknesses inherent in trying to concentrate power in a very small compass and by 1939, owing to the difficulties encountered, all the original machines were out of use.

In 1941, however, by which time a coal crisis had developed owing to war-time depletion of the manpower in the mines, the Bolsover Colliery Co. in the Midlands reached an agreement with the Mining Engineering Co. to build a new Meco-Moore as a joint enterprise, and by the end of the year the first of these improved machines was put to work.

At that time the productivity being obtained by conventional methods in some of the Bolsover Company's workings was as high as 7 tons per manshift at the face. The Meco-Moore, however, soon demonstrated that the same output could be got from such faces with a saving of 11 men and a consequent increase of the output per manshift to 9 tons. Moreover the work was lighter, less active men could be employed in the team and there was a striking reduction in absenteeism. In later years the productivity from this machine in the six Bolsover collieries in which it was introduced was further improved, giving outputs ranging from 9·8 tons on standard 150 yd. faces to 11·6 tons in the better conditions of Thoresby and Clipstone Collieries, where 175 yd. faces and double-shift operation were possible.

The Meco-Moore is essentially a development from the coal cutter, having, instead of one cutting jib, two horizontal jibs to free the coal at roof and floor level and a third triangular shearing jib which cleaves the coal from the back of the cut; a short traverse conveyor serves to move the falling blocks of coal on to the face conveyor.

Thus, for the first time, the cutting and loading of coal in one operation was established. Productivity in favourable circumstances increased by more than 50 per cent compared with orthodox working.

It should be noted that an ordinary belt conveyor was used to take the coal away from this machine.

The Armoured Flexible Conveyor

The armoured flexible conveyor, which was introduced from Germany into this country about 1952, was the next step forward. It is a very heavy and robust piece of equipment which is quite impossible to dismantle and rebuild in a new track as is customary with the belt conveyor. It became necessary, therefore, to devise a new system of roof supports which would allow the conveyor to be moved forward in small steps and kept close up to the coal face. This system is commonly known as the prop-free front.

Yielding Hydraulic Props

Britain's special contribution in this field has been the development of the adjustable hydraulic prop, which works on exactly the same principle as the hydraulic car jack, and which can be just as speedily and easily jacked up to roof level or, alternatively collapsed and withdrawn. I should add that the maximum pressure load appropriate to the particular roof and floor conditions can be pre-set on the prop, a release mechanism operating to liberate the pressure should it build up beyond the proper load.

Powered or 'Self-Advancing' Supports

The next simple logical step was to join up the props in frames or tiers of two or three props in depth, carrying rigid roof bars like inverted skis, and to link these frames to the conveyor by horizontal hydraulic rams. If alternate tiers of props are jacked up to the roof, they will give the necessary purchase for the rams to push forward the conveyor together with the intermediate tiers of props which are in the released position. As soon as the latter are in their new positions, they can be jacked up so as to anchor the conveyor and enable the rams to go into reverse and draw forward the first set of props which are now in their turn released. As the power loader moves slowly along the face cutting out its web of coal, the props and conveyor will then shuffle forward to close the gap behind it like a line of steel robots caught in a slow-motion three-legged race.

This is no surrealist fantasy but actual fact, and there are now some 20 installations of so-called 'self-advancing' support systems in our mines. These systems are fully power-operated, but each support tier has to be individually controlled by workmen dodging in and out among the rows. The next step forward must therefore be to apply remote control to the whole system on the face, including the power loader itself, and experimental work on remote control is in fact in progress.

The successful application of the armoured flexible conveyor in conjunction with the new support systems opened up a new field for the application of

loading machines. The armoured flexible conveyor was sufficiently robust to permit a loading machine to ride on top of it.

The Anderton Shearer Loader

The Anderton Shearer Loader, invented by James Anderton in 1952 when Area General Manager of the St. Helens Area in Lancashire, was one of the first machines to be developed to ride on the armoured flexible conveyor. It consists of an ordinary coalcutter with the normal cutting jib replaced by a drum armed with cutting picks, and with a deflector plough added to push the cut coal on to the conveyor. It is simple, easy to install and maintain, and capable of tackling most conditions, so that it rapidly became the most popular of the new machines and now accounts for one-third of all power-loading installations in this country.

The Trepanner

Ideally, the Anderton Shearer, having cut along to the end of the face, would reverse and cut back in the opposite direction. Although a double-ended version is being developed, the present models are not capable of coal-cutting on the return run.

One of the most promising of our newer machines, however—the Trepanner—is double-ended and cuts in both directions. The cutting member of this machine is a trepanning wheel armed with picks which cuts a passage in the coal, rather like coring an apple, the coal in the core being broken and thrown on to the armoured conveyor.

I have given you some information on the Anderton Shearer and the Trepanner because they are the two outstanding British developments in this field, but there are others, such as the coal plough, which are also in suitable circumstances giving excellent results.

Continuous versus Cyclic Mining

It is important at this point to note that the later machines which I have described have brought about a further revolution in mining technique comparable to that caused by the introduction of the coalcutter and conveyor fifty years ago. The latter gave rise to the system of cyclic mining in which, simply stated, the face was cut during the night shift, shotfiring and handfilling of the coal occupied the day, or coaling, shift and the afternoon shift was given over to manhandling the conveyor and roof supports forward to the new alignment of the face. The armoured flexible conveyor, moved forward by power and associated with the Anderton Shearer, or other similar machine, and with quick-setting hydraulic props or the new self-advancing support systems, has introduced an entirely new conception of 'continuous' mining in which all the main tasks at the coalface are done simultaneously, and in fact repeatedly, during the same shift. In theory, therefore, so long as the ancillary tasks can keep pace with the speed of advance of the face, every shift can now be a coaling shift.

In practice, however, we have not yet been able to reach this pitch of efficiency and perfection, although in the more favourable conditions there are numerous Anderton Shearers as well as Trepanners now managing to work

regularly on two shifts in every three, with consequent benefits in improved output per manshift and lower costs of production. In these instances rates of advance up to 54 ft. per week, and face O.M.S. up to 12½ tons, are being achieved.

Road-Making a Limiting Factor

The principal obstacle to full continuous mining at the present time is the speed of road-making, or ripping, an operation which I have not yet mentioned. The transport roads which run off at right angles from the face must be ripped forward as the face advances, and the ripping dirt packed in the edges of the waste to form the walls and support the roof of the extending road, which is of course normally higher than the coalface itself. If the ripping of the clearance roads fails to keep up with the advance of the face, the coal-getting machine must sooner or later be brought to a standstill, and this is our present difficulty. Although a machine called the slusher packer has been developed to ease the task of packing, the problem will not finally be solved until we have a ripping machine which will eliminate the use of explosives at the ripping lip and which will, in one operation, get down the requisite amount of dirt and stow it in the gateside packs.

The Large Coal Problem

Latterly, we have run into another problem of quite a different kind, namely, the shortage of large coal for the railways and for the domestic market. The supply of coal in sizes over 2 in. has been a declining percentage of total output for many years, but undoubtedly the increased use of power loading and other machinery in the mines has speeded that decline. Some of the most useful and most productive of the machines, such as the Anderton Shearer, have the worst records as breakers of coal, and it has recently been necessary to redeploy our available machines so as to use in the seams supplying the large coal market only those which produce a high percentage of large coal. This process of re-deployment, which is still in progress, has unfortunately caused some loss of momentum in the drive for mechanization at the coalface. I believe, however, that the problem will be of relatively short duration as the large coal market shrinks year by year.

In the industrial field, while no problem is presented by the 2 in. to 0 in. category, it is nevertheless important not to produce too high a percentage of very fine coal in the $-\frac{1}{2}$ mm. category, which can give rise in the normal industrial boilers in use to a problem of grit emission, and in the case of washed smalls will prevent the coal from flowing easily in bunkers. The power stations, on the other hand, want small coal and will require it to be crushed if it is too big; their requirements do not conflict at all with the advance of mechanized mining.

MACHINES AND MEN

Coal, however, is not got by machines alone, and we have to consider the human beings who have to work in the pits and what effect these machines will have on them.

In the old days mining was a family affair and it was usual for the father to be in charge of a stall and to take his sons to work with him when they were old enough. All the power required for getting the coal, making roads, drilling holes, setting supports, etc., was human power and the only help at the face was from explosives. It was even usual to push the tubs of coal quite long distances to places where the roads became large enough for ponies. Although it was hard work at the coalface, it was usual to find family pride in tasks well done and real skills were to be found, for example, in the way a man would use his pick on the face in such a manner as to persuade the forces of Nature to do much of the work of getting the coal for him. It was the invariable custom for men in a stall to be paid by the amount of coal they produced, and long before the beginning of the twentieth century price lists existed for paying men by contract for different tasks at the coalface.

With the advent of the conveyor, which brought the first concentration on shorter lengths of face, it was quite usual to find on big faces teams of thirty to fifty men filling on to the same belt, and it became necessary for all to be paid a common wage—still, of course, related to the total tonnage filled. This monotonous job of filling coal day by day compared unfavourably with the earlier system whereby the miner not only did the filling but also the getting of the coal, the ripping, the packing, setting of supports—in fact all the various skilled tasks at the face. The new system also had the disadvantage that any man of more than average physical ability, wishing to earn rather more than some of his mates, was not able to do so because all went into the common pool. It is true, of course, that rippers and packers and cutter men remained in relatively small teams, but they still had a much narrower field in which to work and there was more monotony than previously, although this very system had substantially reduced the amount of physical work in each of these different fields.

Mechanized mining to-day has taken another great step forward so far as the filler is concerned. A small team of men now operate a machine which does all the hard work for them and there is ample evidence of a return of the old team spirit. On such faces the pick is virtually obsolete, the shovel little used and men have only to guide and control their machine and set the supports behind it. Conveyor men no longer dismantle and re-erect the conveyor by hand but use compressed air or hydraulic power to push it forward to its new position. Rippers still have some heavy work to do, but the machines already available have done much to reduce their load.

One of the greatest difficulties in paying a man by the amount of work he does has always been that he is working in surroundings which can vary from day to day, due simply to the fact that geological conditions can themselves vary as rapidly. Methods of payment by contract have always been based on what are assumed to be average conditions in the particular circumstances, and it has always been difficult to assess precisely the effect of day-by-day variations on which allowances for difficulties were payable. The result was that the

industry's wage negotiation system in the past was very much a catch-as-catch-can affair under which employer and workman alike sometimes got a good bargain and sometimes a bad one.

Method Study

Now, however, we are beginning to apply the techniques of Method Study, and more particularly of Work Measurement, to the problem of setting a reasonable task to which a reasonable wage can be attached. I am quite sure that the objective approach offered by these techniques must give a consistently fairer deal to employer and workmen alike and, at the same time, ensure more efficient utilization of valuable machinery. I am glad to say that steady progress is being made in this direction, and in certain Areas all power loading contract agreements are settled on the basis of method studies as a matter of course and with the willing co-operation of management and men. It seems to me significant that these are Areas where men's earnings, their productivity and the profitability of the pits are among the highest in the country.

CONCLUSION

I hope I have said enough to show you that very great strides have been made in the last few years towards improving efficiency at the coalface, although much remains to be done. The percentage of output got by power-loading to-day is still only 28 per cent, and even within that 28 per cent, maximum efficiency is not yet achieved.

I am convinced, however, that in the long term the demand will be for the smaller sizes of coal and that this will inevitably favour the fullest possible development of mechanized mining.

The rate at which we have improved efficiency has not kept pace with the American rate; our wages bill, which has been subject to general inflationary pressures, has risen considerably more than American wages. In consequence of these two factors, our prices have risen much more steeply than American prices.

Oil has become for the first time seriously competitive in our home markets, and nuclear energy looms as a possible new competitor. We must therefore concentrate our attention on improved efficiency and productivity in order to maintain our present predominant position, notably in the ever-expanding field of electricity generation. This is the task and I do not seriously doubt that in the end we shall achieve it.

DISCUSSION

MR. G. VIVIAN DAVIES: Having listened to the facts which Mr. Longden has given us, it seems extraordinary that the Ministry of Fuel and Power should have so miscaculated the need to force power stations, industry and large buildings to change over to oil. Having made special efforts to make oil available, we have got to make use of it. It seems to me, Mr. Chairman, that there is a great need for a National

Fuel Policy; if we had had one, this sort of miscalculation most likely would have been avoided. Of course, it may be that this drive for fuel efficiency has reduced the consumption of coal in industry. I remember some years ago a well-known fuel technologist telling me that if only the price of coal was something between £5 and £10 a ton people would not be so very wasteful. We have now reached that stage.

Mr. Longden referred to the gas industry and said its reduced consumption of coal reflected the change over to electricity and the effect of one mild winter. There is another factor, of course, and that is that the industry is tending now to produce more and more gas from oil. I should like to ask Mr. Longden why there was a two per cent drop in exports between 1956 and 1957. I should have thought that period would have been the time to put exports up. Another figure which astonished me was (if I read it correctly) that the output per manshift in America is six-and-a-half times what it is in this country. That seems a tremendous difference. Lastly, I should like to ask Mr. Longden what has happened to the hydraulic cutting of coal which looked so promising at one time? What about the Samson stripper?

THE LECTURER: First of all this main question of turning over power stations from coal to oil: I think we must be fair about this and remember that it is always easy to be wise after the event. At the time—as I think I said in the paper—it seemed that the mining industry was going to have a tremendous struggle to cope with the ever-increasing demand for coal year by year right up to 1970; and therefore, to find suddenly that there has been some recession and that in fact supply now exceeds demand, throws a completely different light on that particular issue. You drew attention to the small fall in exports between 1956 and 1957. I feel that that is a very small figure; not insignificant, certainly, but you have got to bear in mind the problems in Europe. In Europe, they are to-day putting a lot of coal on the ground. Moreover, because we have been unable since the war to re-enter the old markets which had belonged to us for generations, Europe has had to go to America to get its coal; and in consequence it has made long-term contracts in America, which means that we cannot just walk back into our old markets. It is going to be a long, hard grind getting there, and when we have got there we must be able to assure our customers that we will be able to continue to supply them regularly.

You rightly draw attention to the very great difference in output per manshift in America and in this country. Now that must always be so. The circumstances in which they do what they call deep mining in America are very different from ours. Their normal sort of depth is about 100 yards. They normally extract only about fifty per cent of the coal, so that they can compete first of all with open-cast mining. I need not describe that to you; I am sure you have probably seen some of it up and down this country; the Americans do it, of course, in a very big way and they get extremely efficient production—about twenty tons per manshift worked. Because of this difference between their mining conditions and ours, we never shall achieve their figures, but the significant figures that I showed you were the *increases* in efficiency which they have achieved over the ten-year period; and I suggest that, whilst we may have to begin from a lower level than the Americans, there seems to me no good reason why we should not attain the improvements in efficiency that they have achieved. We can never hope to reach their actual figures.

You also mentioned hydraulic mining and the Samson stripper. The Samson stripper was a magnificent machine. It still is, in its way. We have got three working to-day and they are doing very well—as well as any machine we have got—but for its success the Samson stripper depends entirely on the strength of the roof and the floor of the seam being worked. This is because it moves forward entirely from a hydraulic jack which jacks the main pillar of the machine between the roof and the floor, and in actual practice we have found that we have very few seams where

the cylinder does not damage the roof and the floor and break them both up, and consequently make the machine unusable.

MR. G. KEITH ALLEN (Royal School of Mines): Roughly a year ago I saw a model of a very large tunnel boring machine at Bretby Research Establishment. Could Mr. Longden tell us what progress has been made with that machine?

THE LECTURER: The tunnelling machine is of course still under construction, and as you probably know, it is the first of its type that has ever been attempted, and is designed to cope with virtually any sort of strata. As with most things that are completely new, I am afraid we have been rather slower in getting it going than we had hoped. By the Grace of God, we shall have it running by about the middle of next year.

SIR JOHN HACKING: I should just like to ask the lecturer if he could tell us something about the policy of the National Coal Board with regard to the cleaning of coal. He dealt with the 'getting', but he did not mention the question of cleaning.

THE LECTURER: Cleaning the coal is, I think, essentially a problem of producing qualities suitable for the differing markets that we have. Putting it at its simplest, any coal that needs to be cleaned we should wish to clean mechanically. It has been customary in the past always to clean the largest sizes of coal by hand. We were in the process of changing over to cleaning all those large coals mechanically, but this meant that the very large coals, those more than about eight inches in size, had to be cracked so that they would go through the washing plant. Now, because of the temporary shortage of large coal to which I referred, we have had to go back in some cases to hand-cleaning, because when you crush or crack the coal it inevitably makes quite a fair proportion of small products, but we shall undoubtedly in the long term return to washing the large coal. We shall wash all the coal that we produce except that which is required dry—and obviously the biggest single customer for that is the Electricity Authority. The Electricity Authority requires a dry coal by choice and it is not fussy about a reasonable ash content provided that that ash content is consistent; what we have to ensure is that consistency. Provided we can do that, I think it is best for the Authority and for us if those coals are not washed; but for other markets we wash all our coals right down to the smallest sizes. To-day we wash even the very fine coal and mix it back with the smalls because it is just as good for most purposes as the somewhat larger coal.

MR. E. C. SEED: I have listened with very great interest to Mr. Longden's most lucid exposition of the principles and practise of coal extraction, from which it is evident that the most efficient methods appear to produce the smallest sizes of coal. Would it not be better to mechanize fully, thereby making nothing but small coal, and then stick it together again if necessary for household and other uses? Has there been any experimental work done in that direction, and what does Mr. Longden think of the idea?

THE LECTURER: First of all, from our point of view full mechanization is obviously the most efficient way of producing. About eighty-five per cent of the coal that is produced in the United States to-day is crushed down to one-inch-and-a-half in size, and because that has become virtually their standard product, coal preparation is very much more simple, and they work with much simpler plant than we do. We have processes which are capable of sticking small coal together again, but those processes are all relatively expensive in themselves. The biggest problem is that for a very substantial capital outlay you only get a relatively small through-put, and you can very quickly spend twenty to forty shillings a ton on sticking coal together again. Therefore I do not think that this is a process which we want to undertake in the normal course. I am not, of course, referring to specialized markets like those for

smokeless fuels, but to the principle of getting all our coal as small coal and then just sticking it together.

MR. N. R. SMITH (East-Midland Division, National Coal Board): May I follow up those last two questions by asking Mr. Longden if he can tell us something of the developments which are taking place, or are likely to take place, in respect of using coal in other ways than for conventional burning? I am thinking in particular of complete gasification. Work has been started, I believe, at Westfield in Scotland on a big installation based on the Lurgi process. Obviously if we can use large quantities of low-rank high-ash coal (which, without expensive cleaning processes, it is difficult to burn), as a fuel suitable for conversion to gas, I think we could increase the overall efficiency of the coal industry. Is there, perhaps, the possibility of using such gas as the raw material for other synthesis processes? Large tonnages of low-rank coal are not only readily available in the Midlands, but the costs of production in general are much lower than for the normal gas-producing coals.

THE LECTURER: I have said in the paper that in my view the low-rank high-ash coal will in future be used largely for electrical generation. But if there is a demand for gas, then the Lurgi process will allow these fuels to be used instead of the traditional high-grade gas and coking coals. The gas industry is at present experimenting with this type of plant.

SIR GODFREY MITCHELL (Chairman, George Wimpey & Co.): I expect half of us are wondering whether we can coax Mr. Longden on to the question of what they really do in Russia by underground gasification, and whether we are learning from their practice in this field anything which will be of benefit to this country.

THE LECTURER: Yes, underground gasification is rather different. We have been doing some experimental work in conjunction with the Ministry on this. I think it is very important to consider the circumstances in which this is a possibility. In this country, with our old coal-fields and high-grade qualities of coal, we began hundreds of years ago at the outcrop and worked downwards. For gasification to work at all at the present time, it seems to me necessary to find a seam of coal which is relatively near the surface. The amount of such coal we have left is not very substantial, it is in small isolated parcels, and the quality not ideal. Additionally, if the areas are badly faulted this further complicates the problem of gasification. So my bold answer to you would be that, in this country, I see no future for underground gasification at all. That is a purely personal view. In the U.S.S.R., the picture is completely different. They have got, I suppose, the biggest reserves of coal in the world. A very large proportion of them are near the surface. The Russians can afford, if it suits them, to tackle any scheme in a way which does not have to take into account conservation of total resources. Although gasification is extravagant in this respect, it may in certain circumstances suit them to do it, but if one is talking in terms of the most efficient means of getting heat units out of the ground, I personally see no future for it in Great Britain, and I should have thought that on straight economics it was doubtful even in Russia.

MR. G. VIVIAN DAVIES: I saw the Russian exhibit at Brussels. It was a very big and imposing one and I gather that they, even with their more favourable conditions, had the same troubles as we have—that is to get the stuff alight and keep it alight and then to know what to do with this very low calorific-value gas that results. I was rather disappointed, because I thought the Russians were even further ahead than this exhibit indicated.

SIR ANDREW BRYAN: Would Mr. Longden care to express a view on the possibilities of getting coal at the actual face by hydraulic means and of hydraulic transport of the

coal underground and through the shaft? Secondly, he would like to express a view on the possibilities of getting coal by explosives again, in the very same way as you pulse-infuse and shotfire?

THE LECTURER: We are at the present time experimenting on a fairly small scale with the possibility of tackling hydraulic mining. We have already proved that we can, without difficulty, use hydraulics for transport on the level, and also that we can pump coal up the shaft without any great difficulty. It does mean, of course, that all the coal that is pumped has to be relatively small—otherwise the pipe diameters become so big as to be quite uneconomic and unwieldy. It means, too, that all the coal got out is completely wet, and so there is the problem, at the coal preparation end, of dewatering. Otherwise it is completely efficient. It can obviously be used in underground roadways that are relatively small, but of course it still leaves the underground problem of transporting materials and men and so on, so that you have to have another transport system as well as hydraulics. Hydraulic mining is used in the U.S.S.R. to a limited extent. We are about to start an experiment at one colliery, but we believe that if it is to be effective favourable conditions are necessary. First of all, we must have some sort of gradient so that the water will run away when you have used it at the coal face; secondly, I am quite sure that we must have coals that are sufficiently soft to be able to work reasonably with a jet of water. We do know that the Russians, for example, are already working on higher water pressure than they originally used, and we also have already set about working at still higher pressures.

So, whilst it is possible that in certain circumstances hydraulic mining will be worth while, we are not yet in a position to say that we have really been successful with it.

Sir Andrew also referred to pulsed-infusion, which of course is a very valuable development from our normal means of using explosives underground, and it has undoubtedly made the whole process of shotfiring much safer than it was before. This has enabled us to fire shots off the solid, and this has proved particularly valuable at the ends of mechanized faces. It has also reduced the amount of dust dispersed into the air during shot-firing. I think this method of firing will continue to increase.

THE CHAIRMAN: We have had what I regard as one of the outstanding lectures of the year, and it remains for me to move a general vote of thanks to Mr. Longden for his very comprehensive and lucid paper. It would be superfluous for me to try to pick out anything from the paper for comment. What I should like to do is to congratulate Mr. Longden, on your behalf, for having so successively compassed such a range of material within so comparatively short a space of time.

The vote of thanks to the Lecturer was carried with acclamation and, another having been accorded to the Chairman, the meeting then ended.

SPECIAL HYDRANT-INDICATING NAILS

THE FOTHERGILL PRIZE ESSAY*

By E. C. SIMPSON, G.I.FIRE E.,
London Fire Brigade

One of the difficulties experienced by firemen in congested cities is the inability to locate hydrants quickly. In particular, the English practice of situating hydrants below ground level makes their identification and location a problem in this country. If an indicator could be provided, whereby firemen arriving at the scene of a fire were immediately shown the way to the nearest hydrant, precious seconds would be saved and public criticism avoided.

The purpose of this essay is to suggest the establishment of a system which would enable the crew of a fire engine, by merely looking out of the window as their machine arrived at the kerbside, and even in the light of hand torches, to make out the direction of the nearest hydrant.

The necessary equipment would consist of shaped nails, between six and nine inches long, which could be driven into the pavement between the walking surface and the kerbstone. Three shapes of nail would suffice: (1) diamond, (2) triangular, (3) oval.

The diamond-shaped nail would be used at a point midway between two hydrants, indicating that these are equidistant—one for immediate use and the other in reserve, in case more water is required. The triangular-shaped nail would be the more numerous type used, occurring at regular intervals between the diamond-shaped nail and the actual hydrant, the apex of each triangle pointing out the direction of the latter. The apex of the triangular-shaped nail nearest the hydrant should point inwards to it, because it is not unknown for hydrants and their tablets to be covered by stacks of bricks, piles of sand, and other similar obstructions. The nail of oval shape would indicate that the hydrant was on the other side of the road; but as it is undesirable to disrupt traffic by strewing hose across thoroughfares, this type would only be used sparingly, and mainly in mews and culs-de-sac.

A standard must be laid down to govern the distance between each nail and its neighbour. Most appliances come very close to 30 feet in length, so that if a distance of 10 yards between nails were stipulated, firemen would not need to walk further than the length of their machine before finding an indicating nail. However, hydrants have never been, and cannot possibly be, sited at intervals based on exact multiples of 10 yards; therefore it is not feasible to enjoin more than that the distance between the nails remains equal and does not exceed the maximum laid down.

* For this essay Mr. Simpson was awarded a prize of £10. The results of this year's Fothergill and Howard Prize competitons were announced in the November issue of the *Journal*.

The next consideration is the actual installation of the nails. This could be done when the normal hydrant inspection routine is carried out, although the number of days allocated for this combined operation would have to be doubled, or even trebled. This arrangement should not interfere with efficiency now that all fire appliances are fitted with radio and can be directed to a call from another locality almost as quickly as they can be ordered from the home station.

The present hydrant tablets could remain in position as an additional aid to identification. Having found the direction of the nearest hydrant, the fireman would be able to see the tablet after walking along the nails for a few paces.

The officer in charge of the local fire station can be informed when any established nails have been disturbed by road works, and, by mutual arrangement, the nails can be replaced by one or another branch of the local public services.

GENERAL NOTES

EXHIBITIONS ON TOUR AND IN TOWN

Fellows of this Society are as widespread as their interests, and accordingly many will have the opportunity, and will surely welcome the chance, of seeing the Arts Council's touring exhibitions of the work of the late Barnett Freedman and John Minton, both formerly associated with the Royal College of Art. The versatile craftsmanship of Freedman who, before his untimely death this year, had for long been a Fellow of this Society and a Royal Designer for Industry, may be judged at the Harrogate Art Gallery during the first fortnight of December, and thereafter at Nottingham, Lincoln, Newport in Monmouthshire, and finally Derby. During the same fortnight of December, his former colleague, John Minton, will be drawing students to the Towner Art Gallery at Eastbourne, and afterwards at Blackburn, Birmingham, Bristol, and Nottingham. If final judgment of their places in the history of English painting and graphic art as a whole cannot yet be attempted, there can certainly be no doubt whatever of the allegiance and affection they both won as teachers under Professor Robin Darwin at the Royal College.

The difference in their characters was strikingly brought out in their memorial exhibitions held, at the same time, in the Arts Council's London headquarters. A controversialist of decided tastes and prejudices, pungently expressed, Freedman was a conscientious and genial illustrator whose work hardly reveals the bite he could impart to a riposte. 'What do you mean by commercial art'? he once demanded of a student. 'There is only good art and bad art.' That remark (which might have come equally from Frank Pick of the London Underground) is the clue to the scrupulosity of Freedman's posters, book jackets, illustrations, and designs of all kinds, in which his gifts in colour-lithography, in particular, were exercised with an absorbing passion for exploring all the potentialities of his medium, rather than with any very marked vehemence of self-expression.

Virtues eminently suited to a wistfully pleasing and fastidious illustration could, however, as might be expected, appear as defects in his literal paintings in oils. wherein his use at times of a very warm, not to say hot, colour scheme seemed to represent for him the limit of robustness. But that is certainly not to deny Freedman's feeling for nature in a number of crisp landscape paintings, and still less to underrate the documentary value of his war-time records, which remarkably embraced the most intricate mechanism, and the individual portraiture of all the sixty members of a submarine's ship's company.

John Minton, by contrast, was an introspective person, possessed of quite extraordinary gaiety and charm of manner which masked, however, an intense loneliness

and the psychological stresses which blighted his inner life. To say that much is necessary for the fuller appreciation of Minton's art, so nervously responsive to his complex, ardent, and yet artificial nature. In this touring exhibition, you notice the early influences on him of Berman and Tchelitchev in the paintings executed on the eve of the last war. The unease of his London streets, the mournful intensity of his youths looming up in the forefront, are the beginning of the young artist's wartime romanticism in whose unreality one senses, in his sombre paintings, something of the shadowy cinema. The same sources inspired Mr. Michael Ayrton, who has lent several of his friend's drawings of this period.

By the end of the war, Minton was already perfecting his lyrical style of rural fantasy in a manner far less beholden to Samuel Palmer's drawing than is, say, Mr. Sutherland's of this period. It is not Palmer's solemn hush so much as a sense of foreboding and, in time, of the mysterious aura of exotic places, which Minton could convey in pen drawings so suggestive of torrid light and colour as scarcely to need the rusty pink and viridian of later years. In this exhibition, it is a creamy painting of *Cranes on the South Bank*, 1946, which marks the beginning of his most characteristic, patterned painting, and a closer affinity with Colquhoun than with Ayrton. Thereafter, for all the variations of invention and stylization, Minton's peculiar style was formed, remaining instantly recognizable across the length of a gallery, even after the rigidity of the Spanish bull-fighters and the rest had given place towards the end of his life to a more flexible, fluid and calligraphic stroke. In his later period he set much store by his translations of historic compositions into his peculiar idiom, of which *The Death of Nelson*, after Maclise, is the earliest and the most dramatically convincing. Nevertheless, it may well be for Minton's landscapes, and the most searching of his portraits, that posterity will come to respect him increasingly when the painters of our day can be seen in truer perspective.

Meanwhile, in London there have opened three exhibitions of notable interest to students of modern movements in art. In the Whitechapel Art Gallery hang the huge, obsessional decorations of the American, Jackson Pollock, who had created a legend even before his death in 1956. To the Tate Gallery, under the auspices of the Arts Council, comes the collection of surrealist pictures amassed by the Belgian, M. Urvater, more comprehensive than any representation of this movement seen in London since the Surrealist exhibition of 1936; while the Hanover Gallery celebrates the recent work of Mr. Eduardo Paolozzi, the youngish British sculptor whose pieces have already entered the leading museums of New York.

Jackson Pollock, as is generally known, was a pioneer of that mode of so-called automatic painting which the increasing school of 'action' painters has since exploited. At Whitechapel, however, it becomes quite clear that Pollock left far less to chance in his intricate designs of skeins of paint than was originally supposed. Never, one surmises, was a pioneer more conscious of the effect he would eventually produce whether employing the brush or the dripping stick, whether adumbrating a Picassoesque image or, more personally, allowing his arm to swing freely in linear arabesques. So far from disturbing, in fact, the impact of Pollock's later veined designs is often weakened by the very charm of their decorative devices. The collection also traces the artist's earlier development, but it is through his obsessional designs after 1946 that Pollock has become internationally celebrated, or notorious, as the case may be. It is not improbable that the judgment of future art historians will be Mr. Eric Newton's verdict the other day: 'It is, perhaps, an unimportant gift but no one else has exercised it with such assurance.'

The surrealist collection of M. Urvater's at the Tate, which includes the grisly inventions of Max Ernst and Klee's tragi-comic conceits, with examples of Miró, Chirico, Dali, Magritte, and others, may be allowed to speak for itself in accents at once familiar and disquieting. As disquieting are Mr. Paolozzi's automatons at the Hanover Gallery, and these are unfamiliar—at least, to those who do not recognize

in them the brutish art of a Dubuffet, realized in a basis of mechanical bric-à-brac, reared on stilts, and cast prodigiously in bronze. The sense of an inscrutable presence, instinct with life of its own, is more sharply experienced in one or two figures than in others, but the vitality which informs Paolozzi's smaller grotesques remains irresistible.

NEVILE WALLIS

THE DUKE OF EDINBURGH'S PRIZE FOR ELEGANT DESIGN

The Council of Industrial Design has announced the establishment of the Duke of Edinburgh's Prize for Elegant Design. This annual award has been instituted on the initiative, and through the generosity, of His Royal Highness, and it will be given for 'a contemporary design in current production distinguished by its elegance'. Only manufactured goods in production which have been exhibited at the Design Centre will be eligible for consideration.

The winning design will be chosen by an independent panel of four judges appointed at the invitation of the Duke of Edinburgh. His Royal Highness, or his nominee, will act as chairman of the panel, which, for 1959, will also comprise Lady Casson, Miss Audrey Withers, Mr. Basil Spence and Sir John Summerson. The prize may take whatever form the winning designer chooses, provided that this does not cost more than £100 and can carry a suitable inscription. The award will be made public at the Design Centre on the occasion of the presentation of certificates for the 'Designs of the Year'. The actual prize will be presented at the same ceremony in the following year, to allow time for it to be made.

LEVERHULME RESEARCH AWARDS, 1959

The Leverhulme Trust again invites applications for fellowships and grants in aid of research. These awards are intended for senior workers of established position and are limited to British-born subjects normally resident in the United Kingdom. (In exceptional circumstances the Trustees may waive the condition as to residence.) No subject of inquiry is excluded from consideration, but preference is given to subjects in which existing provision for research is inadequate. The duration of the awards does not extend over more than two years or less than three months, and the amount depends upon the nature of the research and the circumstances of the applicant.

Application forms and further details may be obtained from the Secretary, Leverhulme Research Awards, St. Bridget's House, Bridewell Place, London, E.C.4. The closing date is 31st December, 1958.

GEORGE STUBBS: REDISCOVERED ANATOMICAL DRAWINGS

An exhibition of recently discovered anatomical drawings by George Stubbs is on view at the Arts Council Gallery, 4 St. James's Square, until 13th December.

In May, 1957, during a programme of recataloguing, four volumes of manuscript and 124 drawings by Stubbs came to light in the Free Public Library, Worcester, Massachussetts, where they had lain unnoticed since 1863. They relate to his *Comparative Exposition of the Anatomy of the Human Body with that of a Tiger and a Common Fowl*, a work which he began at the age of 71. The drawings, of which 55 are included in the exhibition, not only reveal Stubbs' powers as a natural scientist but also throw light on his art. The hours of viewing are as follows: Mondays, Wednesdays, Fridays, Saturdays, from 10 a.m. to 6 p.m.; Tuesdays, Thursdays, 10 a.m. to 8 p.m. There is an admission charge of 1s.

THE MURRAY GRAHAM COLLECTION OF CARPETS

Until 1st January, 1959, the notable collection of Turkish, Caucasian and Persian carpets formed by the late Judge Murray Graham, C.M.G., O.B.E., is being shown

in Room 45 Annexe of the Victoria and Albert Museum. Many of the best types of small rugs, prayer carpets and runners which can still be used on floors to-day are included in the collection. They are supported by a number of pieces from the Museum's own reserve collections. The splendid Shah Abbas carpet from Hardwick Hall has also been lent for this exhibition by the National Trust. Admission is free.

STUDIES IN THE SOCIETY'S ARCHIVES III

Notions of Economic Policy Expressed by the Society's Correspondents and in its Publications, 1754–1847: (ii) The Employment of the Poor and the Preservation of the Structure of Society*

The 'employment of the poor', a time-honoured justification for Tudor and Stuart enactments, may have seemed an anachronistic motive when put forward in the Society's Charter of Incorporation in 1847.[1] In fact, it had preoccupied members since the Society's foundation—a foundation which was itself partly the result of Shipley's compassion for the poor of Northampton.[2] Writing in 1758, a manufacturer of paper hats boasted that he had 'for several years Past Kept Several Hundred Persons Employed'.[3] Ten years later the Society was urged to adopt an investment scheme which 'would employ thousands of the poor'[4] and in 1775 the inventor of a corn mill made an eloquent declaration of his charity. 'Gentlemen, [he wrote] I am willing for the good of the Poor in particular and Mankind in general, to empart the talents Providence Endowed me with, For I would be understood as only an Instrument in his Hand . . . [my corn mill] would not only . . . remove many evils Idleness hath brought amongst [the Poor] but would remove many more evil-minded men hath taken of them, Through their distress and want of Employ.'[5]

Before he had founded the Society, William Shipley had opposed the engrossing of fuel in Northampton, and in the 1760s the Society expended £3,500 on a scheme to improve the supply of fish to London.[6]

> It is no strange Thing to hear that a Merchant has accumulated a Fortune of twenty thousand Pounds in so many Years, while others (whom he is daily fleecing) can scarcely get Bread. Is it a Wonder that there are so many dissatisfied people in the Nation when half a Country is ruined, to enrich a few Individuals? There are those who are continually declaiming against those who are placed at the Head of Public Affairs, without knowing why or wherefore; yet like Cuckoos are always singing the same Tune, and talking about Tyranny and Despotism words they scarcely know the meaning of; but if there were no petty Tyrants in the Country, nor no Monopolisers of Land and Trade, the Nation would be quick enough.[7]

These were the sentiments of an enemy of engrossing writing in the 1790s. In the same decade the Society received a moving account of the national distress. It described how

> the prices of all kinds of provisions, whether for necessary sustenance, or for comfort of life, have risen to that pitch, that few are the private gentlemen whose fortunes are adequate to the necessary expenditures of their families. The streets in cities and towns are filled with deplorable objects, whose countenances establish want. The Parochial work house full, and the poor-rates increased and increasing. The gaols filled with criminals, many of whom perhaps for committing the crime to gratify the cravings of hungry nature.

The Society was called on to adopt

> an immediate System . . . to remove these immediate calamities were it for no other reason than to prevent those sympathetic impressions made on our

* The first part of this article appeared in the September issue.

minds by the ever-sounding *knells of our bells*, announcing the departure of our fellow creatures for want . . . these unmannerly bells too seem regardless of annoying our men of wealth, while cramming down their throats, the most high spiced and delicious viands.[8]

The needs of the national economy could be used to justify a harder attitude to the poor. The 'staple' trades of the kingdom had to be encouraged,[9] even if this meant the employment of women and children. In his *Memoirs of Agriculture and other Œconomical Arts*, which formed the first published account of the Society's proceedings, Robert Dossie praised the Society's improvements in spinning:

The spinning of Flax, Wool and Cotton . . . which the Society took early under their encouragement. It is unnecessary to expatiate much on the importance of this work: as very evident reasons demonstrate it. Not only several of the most staple manufactures of our country depend on it; but it is the most general employment of the female sex; who are capable of managing one branch, or other of it, at almost every age; whence it must be allowed, nothing could be more beneficial to the public, either in a political or commercial view, than the supplying means to promote the more general application of idle hands to spinning.[10]

Of the carpet manufacture he wrote: 'carding and spinning make a great part of the work: which, consequently, employ women and children; who are thus rendered profitable to the public, and moral in their conduct, instead of being burthensome, or loose in their way of life: as they otherwise would be.'[11]

In 1788 the need to develop the bed-ticking industry was urged on the Society on the grounds that it would 'contribute to a provision for poor women'.[12] Inventions which dispensed with child labour were praised on the grounds that they removed the harm done by the children and not to them. In 1774 a quilting machine was said to be superior to 'the present method' by which a

Man cannot work but in consort with his Boy. That he must labour therefore under many ill-conveniences and suffer much loss, from the Wickedness, Idleness, Carelessness or Ignorance of a boy must appear very evident to every Person who is acquainted with the untoward tempers and dispositions of Children, especially those of the lower classes. It will likewise be confessed a great hardship that a Man who is both a good workman and industrious must depend upon the Humour of a child both for making good work or a quantity.[13]

In the schemes for reforming parish workhouses which were submitted to the Society during the first decade of its existence there is the customary hardness to women and children.[14] A Parish Officer of St. Martin's in the Fields was asked by the Society if he could suggest any manufacture carried on by the poor in his workhouse as worthy of a premium from the Society. After describing how the aged poor pick oakum, the middle-aged wind silk and the female children 'are now on Trial in Working Ruffles in Imitation of Dresden Work', he urged the Society to abandon the idea of awarding a premium 'to them or indeed Parish Poor in General'.[15] A member of the Society who served as an overseer for three years 'found the poor people very insolent and Idle, which in some measure proceeded from the general Notion prevailing amongst them, The Parish is bound to find us, as likewise from their Education in real habits of Idleness and Thieving from their Childhood . . . the Poor Children from their Cradles are whipped to be thieves, the Consequence of which is shocking in Thought.'[16] John Mason Good, the physician and miscellaneous writer, whose *Dissertation on the Best Means of Maintaining and Employing the Poor in Parish Work-houses* was published at the request of the Society in 1798,[17] was no exception in the rigours he prescribed. His general preference for outdoor relief—on the grounds that people worked best in their own homes—however, and his

quotation from Rousseau—'Travailler est un devoir indispensable à l'homme social: riche ou pauvre, puissant ou faible, tout citoyen oisif est un fripon'—may not have been acceptable in all quarters.[18]

For if 'such a society . . . would not only greatly improve our Estates, but open our Hearts and enlarge our understandings; in short make us good Christians, good Subjects and good Citizens',[19] it naturally accepted the class distinctions of an aristocratic age. A special category of awards was created for young amateurs in the Polite Arts,[20] and in 1759, Elizabeth Osborne, who was under 16 at the time, returned the medal which had been awarded to her for her landscape drawing on the grounds that it was indistinguishable from a pecuniary reward.[21] 'It is the Province of Soldiers with Arms to repel the Foe, whilst Gentlemen in affluence support the State, and I presume it is the Duty of the Mechanic to provide Comfort for those who bravely suffer for their Country's sake', was the view of the inventor of a military wagon in 1779. That the vehicle in question was designed to carry the armed forces and not the taxpayers does not reduce the interest of his conception of social obligations.[22] A farmer who had invented a new type of canal lock apologized for the model when he submitted it to the Society in 1785. It 'is but an Indifferent Homely Job, which I hope the Honourable Society will readily excuse, when I assure them that I never was brought to any other Profession but to the art of agriculture'.[23] A Cambridge Master of Arts, who persisted in his attempts to square the circle and to perfect a ventilator, wrote in 1787 that,

> when I have been despised and derided here by Friends, Relations and Others concerning these my Studies, I answer Them I look upon the Society of Arts and Sciences to be a laudable Undertaking and Institution for the public Utility and why do They presume to set up their judgement against some of the prime Nobility of the Nation and others, men perhaps of the greatest Sense and Learning in the Kingdom who have thought it prudent to form themselves into a society . . . my nerves tremble as I write.[24]

'I am a Gentleman by Birth as well as by Education, and one who *scorns* to impose on *so Respectable a Society with false Accounts*', wrote the advocate of an improved method of preserving seeds in 1788.[25] Nine years later an anonymous letter bearing the subscription 'Marcus Aurelius, the Independent Plebian', which referred among other matters to 'the absurdity of many of Dr. Smith's doctrines on the wealth of nations', struck a bolder note: 'From the pen of a plebian you cannot expect that refineness of diction or obsequeous politeness so well adapted (as they ought to be) to catch the attention of fashionable Theorists in agriculture.'[26] But the majority of correspondents pleaded dire poverty and never hesitated to go into details of their troubled circumstances. 'Having a Large Family . . . and the salary of my school being little' (1767)[27]; ' . . . I am in a Low Station in Life, have a Wife and Six children to provide for' (1789)[28]; 'We have had a numerous Family of fifteen children and bring them all up to Labour and Industry' (1814)[29]; 'Gentlemen, you perhaps will find it very bold of a man who has no other title than that of a poor workman nor no other recommendation only his new discovery to intrude upon you (1841)[30]; and 'It is no disgrace to be poor though it is very inconvenient' (1845).[31] These quotations provide touching evidence of a belief in the Society's benevolence, and in that of the upper classes it represented, which continued well into the nineteenth century. The Society's attitude was expressed in its address to the Queen on her marriage to Prince Albert: 'It is our most fervent prayer that your Majesty's reign may be distinguished by peace and prosperity which it will be our humble endeavour to promote by holding forth encouragement to the ingenious industry of the working classes.'[32]

Thus to the belief that the national economy should if necessary be strengthened at the expense of foreign rivals was added a concern with the profitable employment

of the lower classes. These were the traditional notions of economic policy inherited by the Society and its correspondents from the 'Mercantilist' writers of the seventeenth century. There was also the suggestion of a Christian concern to protect the poor from exploitation by the rich which had its roots in the policies of Tudor and Stuart governments. Mixed with these older notions, however, were newer concepts which will be considered in the concluding section of this article under the title of 'Internationalism, Scientific Improvement and Humanitarianism'.

D. G. C. A.

1. 'Royal Charter of Incorporation of the Society for the encouragement of Arts, Manufactures and Commerce. Granted in the tenth year of the reign of Her Most Gracious Majesty Queen Victoria, and the 93rd Session of the Society, Anno Domini 1847.'
2. Thomas Mortimer, *A Concise account etc.*, p. 5.
3. R.S.A. Loose Archives, A2/9. R. Elsden, 1758.
4. R.S.A. Guard Books, Vol. X, No. 123. G. Walker, 1766.
5. R.S.A. Loose Archives, A7/29. 'C. W.', 1775.
6. Thomas Mortimer, loc. cit.; *Transactions of the Society of Arts*, Vol. 1 (1783), p. 51.
7. R.S.A. Loose Archives, B5/118. Peter Project (1790s).
8. Ibid., B2/205. *Marcus Aurelius, the independent plebian*, 1796.
9. 'The woollen manufactory, esteemed the staple Trade of the Kingdom.' *Transactions of the Society of Arts*, Vol. I (1783), p. 30.
10. Robert Dossie, *Memoirs of Agriculture and other Œconomical Arts*, Vol. I (London, 1768), p. 93. For Robert Dossie see F. W. Gibbs 'Robert Dossie (1717–77) and the Society of Arts', *Annals of Science*, Vol. 7, No. 2 (1951), pp. 149–72.
11. R. Dossie, op. cit., p. 89.
12. R.S.A. Loose Archives, A15/62. J. Syme, 1788.
13. R.S.A. Guard Books, Vol. B, No. 112. George and Nicholas Freestone, 1774.
14. R.S.A. Loose Archives, A2/10. R. Price, 1757. A printed scheme for expanding St. Luke's Workhouse, Middlesex. In order to make more room for the 'Manufactory' small children were to lie four in a bed; 'as they are made close at the Sides . . . there is no danger of their Falling out'.
15. Dr. Templeman's Transactions (MS.), Vol. 1, p. 49. 8th April (1756).
16. R.S.A. Loose Archives, A1/22. B. Cleeve, 1756. 'Proposals for a scheme to prevent the great Evils so justly complained of, That the Poor in most places are badly provided for; the Public Deprived of the inestimable Value of their *Labour*; That the Expenses in maintaining the Poor are great; that the Money raised for that purpose is ill managed and more by one third part than is necessary for the purpose.' In the experimental workhouse conducted by Cleeve educational provision was made for children but their hours of work do not seem to have differed from those of the adults. For Cleeve see *Dictionary of National Biography*, Vol. XI, p. 23.
17. *Dictionary of National Biography*, Vol. XXII, p. 110; *Transactions of the Society of Arts*, Vol. XV (1797), p. 292.
18. John Mason Good, *Dissertation on the Best Means of Maintaining the Employing the Poor in Parish Workhouses* (London, 1798).
19. R.S.A. Guard Books, Vol. I, No. 42. Charles Powell, 1755. Powell was urging the establishment of county societies on the model of the Society of Arts.
20. Robert Dossie, op. cit., Vol. III (London, 1782), p. 423. A distinction was made between 'young persons' and 'young *Persons* of *Rank* and *Distinction*'.
21. R.S.A. Loose Archives, A3/45–7. E. Osborne, 1759.
22. Ibid., A8/56. John Rowe, 1779.
23. Ibid., A12/16. E. Leach, 1785.
24. Ibid., A14/75. J. Simpson, 1787.

25. Ibid., A15/28. E. Harrington, 1788.
26. Ibid., B2/11. *Marcus Aurelius*, 1797.
27. R.S.A. Guard Books, Vol. XII, No. 67. Robert Harrison, 1767.
28. R.S.A. Loose Archives, C1/51. W. Ranger, 1789.
29. Ibid., B1/264. J. Grist, 1814.
30. Ibid., B2/71. Valentin, 1841.
31. Ibid., B1/406. A. J. Green, 1845.
32. R.S.A., Minutes of Committee of Correspondence and Papers, 21st Feb., 1840.

CORRESPONDENCE

'STONES OF BRITAIN'

From *Lt.-Col. B. C. G. Shore, F.A.M.S., Hon.F.I.Q.S., L.R.I.B.A.*, 20 *Wheatley Street, London, W.*1.

I am grateful to you for publishing my inquiry about Mr. D. A. G. Reid's criticisms of my book, *Stones of Britain*, and to him for replying.

I feel sure that Mr. Reid's opinions are sincere, as are mine, but I do not think he has had time to read this book through or he would not have made the mistakes he has made.

To take one or two points only, I have never made any such statement as 'that lime mortar made from very fine calcium carbonate is demonstrably more injurious (to stone) than lime mortar made from limestone'. I have never used any such words in the book or anywhere else. The statement I have made in my book reads 'Portland Cement is open to the same objection . . . But it has been the observation of scientific workers that the damage caused by Portland Cement mortar is less in degree than that caused by ordinary lime mortar under similar conditions. This observation tallies with the fact that "fat" lime mortar, i.e. lime mortar made from very pure calcium carbonate, is demonstrably more injurious than lime mortar made from limestone. The S.P.A.B. mortar is a compromise: chemically, it is a little better than lime mortar and worse than cement mortar. It has not the objection that it will be too hard for most stones'. I am conscious of the shortcomings of my work but my early life *did* make me careful about the choice of words and conveyance of meaning. Mr. Reid has, inadvertently, misquoted me and misrepresented the complete statement. My statements here are given as the experience of scientific workers and not those of one scientific worker, or one worker of any sort. The experience of those workers may or may not in the long run be confirmed—but it was their experience.

If I have not gone as deeply as Mr. Reid would have liked into the stubject of the development of silicones and of the silicon industry, it was because I thought it was outside the scope of the book. I have dealt with it in much greater detail in the first article of *Building Materials* of June, 1957.

Mr. Reid says 'His only appreciation of the work of other scientists concerns the development of silicones' (this is an exact and full quotation). This statement is just not true, as anyone who has read my book will agree.

Mr. Reid says 'On page 254 he writes a condemnation of earlier work on water-proofing treatments as if he alone had approached this problem with "clear thought and reasonable knowledge".' I wonder whether it really sounds like that: I wrote (page 254) 'This book would defeat its aim of being a practical companion and guide to the practising architect and surveyor if *I attempt to describe* the many materials which have been suggested and tried for the arresting of decay in stonework, and which have failed as conspicuously as *we* can now realise that they would fail, but there are a few which should be cited for various reasons.' I do hope that if Mr. Reid

re-reads this piece with the underlinings I have made for extra clarity he will be able to modify the picture he has formed of my attitude. I do not presume to use the Royal We when referring to my purely personal work.

Yes, as he says 'much more work has been done' than I imply—but this was not the place for describing all the blind alleys. I have followed (and reviewed) work done on the continent and I do not think we (or those with whom I have been in consultation) have found any other country as advanced in experience as we are, except that in the United States workers have had a wider field experience for the observation of the use of silicones. Our need is certainly greater than most. He says my references to interfacial tensions . . . are misleading—but he does not say in what way and I, myself, do not know how they are misleading, but it is a very difficult subject to sketch in a few words.

I hope that Mr. Reid will now be able to salute me with the same respect that I salute him.

EXAMINATION WASTAGE

From *Dr. Ethel C. Venables, University of Birmingham Institute of Education, Selly Oak, Birmingham* 29

I have read with great interest the account of the Conference on Apprenticeship in the current number of your *Journal*.

I think I ought to let you know of an error which is contained in the account of Lord Nathan's contribution on page 831, if only for my husband's sake, since he is much better known as Dr. Venables than I am.

Lord Nathan as President of the Association of Technical Institutions was Chairman when I gave a paper entitled *Placement Problems in Part Time Engineering Courses* to the summer meeting of A.T.I. From Tables I and II on pages 6 and 7 of that paper it may be seen that 60–65% of those who persist long enough to sit the first year examinations eventually leave, having achieved either no qualification at all or with the S1 examination only. If this figure is calculated on the number who register for the course it is nearly 70%, *not* 90% as printed in your *Journal*. The situation is bad enough: it is a pity to make it seem even worse!

NOTES ON BOOKS

INVESTMENT IN INNOVATION. *By C. F. Carter and B. R. Williams (on behalf of the Science and Industry Committee). London, O.U.P.*, 1958. 15*s net*

This is the sequel to *Industry and Technical Progress* by the same authors. Like its predecessor, it owes its origin to the Royal Society of Arts, the British Association for the Advancement of Science and the Nuffield Foundation, which appointed the Science and Industry Committee to investigate factors influencing the rate of adoption of new and scientific and technical ideas by British Industry.

The authors themselves draw, as their first conclusion, that it is not easy to reduce the vast disorder of facts about investment in innovation to an orderly scheme; but nonetheless they have written 150 pages and an appendix, the great bulk of which is well worth reading if it does no more than make one think. Looking into the minds of Directors is no easy matter.

In this age of new inventions and great technical progress there is hardly any industry from agriculture to nuclear power which is not undergoing a more or less violent change in methods of operation, and the problem which faces those who make policy decisions was never more complex. This attempt to analyse the pros

and cons of investment in innovation is therefore timely and merits study by anyone upon whom the responsibility for decision falls. Although in every case the responsibility vis-à-vis workpeople is great, it is even greater when the decision is on behalf of shareholders as well.

Profit as the stimulus to decision is recognized but insufficiently emphasized. The authors infer, quite rightly, that unless development can be profitable it cannot serve the developer, but they seem to be confused between Company reserves (which are accumulated past profits) and current profits. They attribute the urge to introduce innovations to prestige, technical pride, susceptibility to sales pressure (from the suppliers of new machines as well as from their own salesmen), the need to replace out-of-date plant, or to shorten an excessive order book: but each one of these stimuli has at the back of it the further stimulus of profit and consequent continued existence in a competitive world.

Attention is properly drawn to the need for harnessing adequate management skills to these urges to innovate. 'The lack of men of sufficient ability for senior management is an important reason for caution' emphasizes the lack of a sufficient supply of good managers, especially in Britain. If this book does no more than draw attention to the need for management training it will serve a useful purpose; but it certainly does a great deal more than that, for it presents in a readable form the many facets of management thinking.

The authors are least sure of themselves when they come to the financial aspects of development. Whilst they recognize that cash in the developer's coffers is an incentive, they do not lay enough emphasis on the availability of the money from the market to pay for innovation as a deciding factor in making a decision to go ahead with the work.

It was not perhaps part of their task to enlarge upon the ways open to industry to provide itself with the money to develop: that is a pity, for it would have helped many managements if a section had been devoted to this subject.

However, this book will form a useful addition to any business library and should certainly be read by Directors whose duties include those of advising upon schemes for the introduction of 'innovation' into their companies.

NUTCOMBE HUME

MODERN SCIENCE AND THE NATURE OF LIFE. *By W. S. Beck. London, Macmillan,* 1958. 15*s net*

Modern Life and the Nature of Science would have been a more accurate title for this book. It is at its best when discussing the actual operations of scientific research and the relations, if any, between the observations made and the conclusions drawn from them. The bits dealing specifically with life are less satisfactory.

On generalities the book is excellent. It almost deserves publication for the sake of the wider circulation it gives to the classic retort to a scientist who had said that another's ideas were infantile: 'I don't care if they are infantile so long as they are correct'. That illustrates succinctly what is wrong with Nature from the point of view of many scientists and most philosophers—it keeps on being silly, or at any rate irrational. Scientists are well educated, intelligent people who often know perfectly well how Nature ought to be arranged and how it ought to run. But they know this on the basis of past experience and they make the unstated assumption that past experience includes all the agencies, or at least all the types of agent, that exist. Looking back at a finished episode we can laugh at the arrogance of the physicists who thought, at the end of last century, that their subject was essentially complete but for a certain amount of more precise measurement. The time is nearly ripe to look askance at those, in the 1920s, who denied the possibility of continental drifting; drift is now fairly generally accepted, but they could find no forces adequate for the

task of bringing it about. Coming to the contemporary scene; it may well be that there is no evidence that weather is now in any way unprecedented, but the dogmatic assertion that nuclear bombs could not affect the weather is arrogant nonsense. The multiplicity of already known biological influences shields us from similar cocksureness but, as Beck points out, the shielding is not complete.

On the motives that lead people into research and the factors that direct it, Beck is also sound. He says, for example, 'Scientists are not an occult priesthood, science is not wisdom, it is not for the few, it is not the road to certainty. It is rather a way of looking at the world which permits us to extract knowledge from our experience. Furthermore, scientists, as this book has tried to make clear, are people who bleed when they are pricked. Despite the impersonal objectivity of scientific knowledge, the pursuit of science is a fabric of passion and feeling.' He has many shrewd comments on the way science is organized and financed, and on the ways in which 'eminence' can be attained and maintained.

In spite of all this the book cannot be unreservedly recommended. Some casualness towards facts can be excused in a popular book, but there are limits. It is a pity that one chapter should start resoundingly, 'Physics early achieved a sweepingly unifying conception in the discovery of the indestructibility of energy', and go on to contrast this with the late appearance of the cell theory in biology. No doubt the conservation of energy was implicit in the work of Newton, Lagrange and Rumford, but it had to wait till 1837 to be formulated by Mohr, and the cell theory was formulated in the next year. Again; we are told that the first hormone was synthesized after World War II, but adrenaline was synthesized in 1904 and thyroxine in 1927. These, and other, errors do not affect the argument but they are irritating. More serious is Beck's occasional inability to follow his own advice. Thus, just after having wisely said 'We are forced into a completely operational point of view. We must not only prevent ourselves from assuming any properties for the gene that are beyond verification, we must, in fact, define the gene in terms of the actual operations that are performed in dealing with it', he goes on to 4–5 pages of conventional mythology taken from other popularizations on genes and viruses.

The old joke 'History repeats itself and historians repeat one another' applies also to scientific popularizers. Most people would benefit from the rational and sceptical attitude towards science that characterizes this book, but it must be handled gingerly by those who are simply looking for information.

N. W. PIRIE

THE COUNTRY CRAFTSMAN: A STUDY OF SOME RURAL CRAFTS AND THE RURAL INDUSTRIES ORGANIZATION IN ENGLAND. *By W. M. Williams.* (*Dartington Hall Studies in Sociology.*) *London, Routledge & Kegan Paul,* 1958. 25*s net*

This work blows a pleasant wind of realism through a subject which has for all too long been enveloped in a cloud of romantic mysticism and poetic pastoralism. Mr. Williams has here provided a sketch of country life as it is really lived rather than as it is seen through urban eyes and minds yearning for an impossible ideal.

Country life has been transformed in the past half century just as town life has. The development of modern technology has brought a new ease to all living in civilized countries. This has not been achieved without some loss. Prominent amongst its wastage has been the gradual, but as yet incomplete, extinction of the small one-man business, a category which included so many of the rural crafts.

Half a century ago the village was largely self-contained. The provision of buildings, clothing, footwear, some of the furniture and other domestic necessaries was made by tradesmen who lived in the place, and who rarely employed more than one or two assistants. The farmers' and foresters' tools and implements were often made locally, or, if not made, their repair was undertaken by the blacksmith, the carpenter, the

sawyer, the wheelwright. To-day few domestic necessities are manufactured locally. Clothing is mass-produced on a national scale: so is furniture and footwear. The tailor has disappeared; the shoemaker is only a cobbler. Building materials are mainly brought to the village, though there are still village builders.

The transformation of animal into mechanical draught with its greater power and new implements has largely done away with the need for a farrier to shoe horses, and the blacksmith must become an agricultural engineer if he is to survive in the service of farming, or supply luxury goods for an urban market if he wishes to remain a blacksmith. The wheelwright has lost his original business, but new opportunities have opened up for him in the demand for tractor-hauled lorries, van bodies, and so on.

When these tendencies first became strikingly apparent, coupled as they were with the phenomenon euphemistically called the drift from the land, the Government, who had been concerned about the state of agriculture, created the Development Fund by the Act of 1909. The Development Commissioners appointed under this Act finance the Rural Industries Bureau, whose aim was to do what it could to stay the extinction of the rural craftsmen that seemed so likely. The work of the Bureau and the other bodies concerned with this object has been successful in many ways, but it has had to modify its activities from time to time in accordance with changing conditions.

Mr. Williams has examined the causes which are leading to the disappearance of the craftsmen like the village blacksmith, in particular in Devon and three West Midland counties. His survey work is unexceptionable, and the conclusions he comes to almost inescapable. He deals also with so-called rural crafts like pottery and weaving, which are to-day practised mainly by urban immigrants into the villages, who do not aim at a local market. He describes the social relations of the remaining rural craftsmen who serve the farmers and villagers, and does not neglect those of the immigrants. He criticizes the lack of accurate information that still limits the administration of the organization, and the comparatively small funds that restrict its activities. He does not omit to honour the good results that have nevertheless been achieved. His work is one that should be studied by all who love our countryside, and who are, as we all are, either directly or indirectly concerned with its welfare, something that is an essential if our national life is to be well-balanced and prosperous.

G. E. FUSSELL

BIG MOLECULES. *By Sir Harry Melville. London, Bell,* 1958. 15*s* net

This book is based on a recent series of Royal Institution Christmas lectures given by the author, and a sense of the occasion is provided by one of the many excellent illustrations, wherein we can observe the rapt attention of the youthful audience who were fortunate enough to hear the lectures themselves. Cold print is sometimes a poor substitute for the spoken word, and pictures and diagrams no substitute at all for live demonstrations. The book nevertheless makes fascinating reading and the balance between scientific principles and practical applications is very well preserved throughout the work.

A mere glance at the index to the book's 180-odd pages is enough to show the very wide range of topics discussed within the broad framework of six chapters, three of which are devoted to fibres, rubbers and plastics, and one each to the making of big molecules and to the measurement of their size. The final chapter under the heading of 'Polymers' consists of a delightful miscellany lying outside the main structural applications.

All these topics are presented with remarkable clarity. The reasoning is often close but never tedious and a reading of the book will surely do much to excite the

imagination of all those, whether young or old, who allow their minds to become attuned to the subject.

Little or no attempt has been made to introduce a sense of historical perspective, and the work is essentially factual. The omission is doubtless deliberate, but perhaps engenders some feelings of regret. The story of how the very concept of big molecules took shape in men's minds less than thirty years ago and of how much was accomplished by those pioneers who had never heard of them, is always well worth the telling.

Dimensional perspective, on the other hand, is well emphasized at many points. Bigness is a relative term and, as the author is careful to explain at an early stage, a big molecule is in reality 'a very tiny fragment of matter weighing only about 10^{-20} of a gram'.

J. R. WHINFIELD

FROM THE JOURNAL OF 1858

VOLUME VII. *17th December*, 1858

ILL-JUDGING SECRECY

From a paper 'On the Modifications which the Ships of the Royal Navy Have Undergone during the Present Century . . .', by E. J. Reed, who had recently been snubbed by the Admiralty.

And here I may be permitted to mention a remarkable idiosyncracy of Lords of the Admiralty, viz., that they seem to consider it a special function of theirs to deny to the British Press and the British public, and to the natives of minor states from which we have nothing to apprehend, information, and facilities for gaining information, which they cheerfully accord to officers of the French, Russian, Austrian, American, and all other Governments which can by any chance prove inimical to us. I have known Russian officers, in particular, have authority to pass freely over our dockyards, while Brazilian officers are refused permission to enter the gates even to see a ship launched, and while Englishmen have to go about under the *surveillance* of a policeman. While no manifest good results from this system of being needlessly communicative to dangerous foreigners, and needlessly secretive to innocent Englishmen, it has the effect of occasioning much unnecessary and injurious babbling to newspapers and elsewhere. When all that the Admiralty do is done secretly, so far as we are concerned, men the most insignificant, whom a plain fact or two would appal, consider themselves quite safe in penning grandiloquent essays upon Admiralty short-comings; and even just and able men are often betrayed into false criticism. And a greater evil is still to be found in the trouble occasioned by incompetent persons undertaking to do the work which the Government appears to neglect so grossly. Scores of well-meaning men, at this moment, believe that the offices of the Admiralty and the Surveyor of the Navy stand in the midst of all the bustle of modern progress, like a kind of sleeping palace, to the inmates of which—

> Faint murmurs of improvement come,
> 'Like hints and echoes of the world,
> To spirits folded in the womb;'

—such men never thinking for a moment that most of the propositions which they are content to put forward in the crudest possible form, have long since been thoroughly examined, down to their minutest detail, in the offices at Whitehall.

STANDING COMMITTEES 1958-59

Ex officio members are indicated thus (*)
Distinctions after a name which appears more than once are not repeated

FINANCE AND GENERAL PURPOSES COMMITTEE

Sir Alfred Bossom, Bt., LL.D., F.R.I.B.A., J.P., M.P. (*Chairman*)
Sir Edward Crowe, K.C.M.G.
P. A. Le Neve Foster
Sir Ernest Goodale, C.B.E., M.C.
The Earl of Halsbury, F.R.I.C., F.Inst.P.
R. W. Holland, O.B.E., M.A., M.Sc., LL.D.
Sir Harry Lindsay, K.C.I.E., C.B.E., F. A. Mercer, Hon.F.S.I.A.
Lord Nathan, P.C., T.D., D.L., J.P., F.S.A.
E. Munro Runtz, F.R.I.C.S.
Sir Selwyn Selwyn-Clarke, K.B.E. C.M.G., M.C., M.D., F.R.C.P.
G. E. Tonge

PAPERS AND MEDALS COMMITTEE

Sir Alfred Bossom (*Chairman*)
Sir Edward Crowe
R. E. Dangerfield
Robin Darwin, C.B.E., Hon.A.R.C.A., Hon. F.S.I.A.
Sir George Edwards, C.B.E.
John Gloag, Hon.A.R.I.B.A., Hon. F.S.I.A.
Sir Ernest Goodale
Sir William Halcrow, M.I.C.E., M.I.Mech.E.
The Earl of Halsbury
A. C. Hartley, C.B.E., B.Sc., F.C.G.I., M.I.C.E., M.I.Mech.E.
Dr. R. W. Holland
Sir Harry Lindsay
F. A. Mercer*
The Earl of Radnor, K.C.V.O.
A. R. N. Roberts
E. Munro Runtz
Sir Selwyn Selwyn-Clarke
Sir Philip Southwell, C.B.E., M.C.
G. E. Tonge*

COMMONWEALTH SECTION COMMITTEE

Sir Selwyn Selwyn-Clarke (*Chairman*)
Sir John Woodhead, G.C.I.E., K.C.S.I. (*Vice-Chairman*)
L. F. G. Anthony
Sir Hilary Blood, G.B.E., K.C.M.G.
Sir Alfred Bossom*
Sir Frank Brown, C.I.E.
A. T. Campbell
Ben Cockram, C.M.G., O.B.E.
D. J. Finley
Dr. R. W. Holland
Lord Latham, J.P.
Miss Anne Laycock
Sir Harry Lindsay
Roy Macnab
F. A. Mercer*
Dr. M. Moulik
Lord Nathan
P. R. Noakes
Sir Gilbert Rennie, G.B.E., K.C.M.G., M.C.
E. Munro Runtz
Sir Thomas Smith, V.D.
G. E. Tonge*

EXAMINATIONS COMMITTEE

Appointed by the Council:

Dr. R. W. Holland (*Chairman*)
W. Greenhouse Allt, D.Mus., F.R.C.O., F.T.C.L.
Sir Alfred Bossom*
Lord Latham
F. A. Mercer*
Professor R. D. Russell, R.D.I., F.S.I.A.
G. E. Tonge*
H. A. Warren, M.Sc., M.I.C.E., M.I. Struct.E.
Sir Griffith Williams, K.B.E., C.B.

Appointed by Central Education Authorities :

England (Ministry of Education): E. I. Baker, H.M.I.
Northern Ireland (Ministry of Education): J. M. Benn, M.A.
Scotland (Scottish Education Department): A. G. Skinner, H.M.I.S.
Welsh Department (Ministry of Education): Miss Dilys Rees, H.M.I.

Appointed by Local Education Authorities:

L.C.C.: W. F. Houghton, M.A., and
J. G. C. Jackson, M.A.(Ed.), B.Sc.(Econ.), B.Com.
Belfast: J. S. Hawnt, O.B.E., M.Sc., Ph.D.
Birmingham: A. M. B. Rule, M.B.E., M.A., LL.B.
Bournemouth: W. R. Smedley, B.Sc.
Bristol: W. B. Armstrong, M.Sc.(Econ.), B.Com., F.C.I.S.
Edinburgh : J. Dow, M.A.
Essex: B. E. Lawrence, M.A., Ph.D.
Glamorgan: County Alderman Mrs. D. M. Rees, J.P.
Glasgow: T. M. Banks, J.P., M.A., F.E.I.S.
Hertfordshire: S. T. Broad, M.A.
Kent: E. W. Woodhead, M.A.
Lancashire: A. N. Fairbairn, M.A.
Leeds: G. Taylor, M.A.
Liverpool: T. Gore, M.A., B.Sc.(Econ.).
Manchester: R. H. Keast, B.A.
Middlesex: C. E. Gurr, M.Sc., Ph.D.
Nottingham: W. G. Jackson, B.A., M.Ed.
Newcastle-upon-Tyne: H. V. Lightfoot, B.Sc.
Staffordshire: H. Harman, B.Com.
Surrey: A. G. Jarvis, B.Sc.
Swansea: L. J. Drew, M.A., M.Ed.
Association of Education Committees: S. Moffett, M.C., M.A.
Association of Chief Education Officers: V. H. Hoskin, M.Sc., Ph.D.

Appointed by Association of Governing Bodies and Principals of Technical Institutions:

Association of Technical Institutions: M. W. Mitchell, B.Com., B.Sc.(Econ.).

Appointed by Teachers' Associations:

Association of Principals of Technical Institutions: D. E. Mumford, M.A.
Association of Principals of L.C.C. Colleges of Commerce: D. Wilsden, M.A., LL.B.
Association of Principals of L.C.C. Day Colleges and Commercial and Technical Colleges: L. E. Pead
Association of Teachers in Technical Institutions: F. B. Garfoot, A.C.I.S.
National Federation of Continuative Teachers' Associations: J. F. Nicholls
National Union of Teachers: J. V. A. Long, F.B.S.I., F.I.A.C.

Appointed by Commercial and Professional Bodies:

Association of British Chambers of Commerce: J. G. McMeeking, C.B.E., F.I.I.A., F.S.M.A., J.P.

Association of Certified and Corporate Accountants: F. Cameron Osbourn, M.B.E., B.A., LL.B.

British Association for Commercial and Industrial Education: H. Watton Clark, M.A., M.Comm.

Chartered Institute of Secretaries: A. Gale Johnson, F.C.I.S.

Clothworkers' Company: Major W. Guy Horne

Federation of British Industries: Dr. W. E. de B. Diamond, M.A., F.R.I.C., F.C.I.S.

Institute of Bankers: H. Eason

Institute of Chartered Accountants in England and Wales: J. H. Mann, M.B.E., M.A., F.C.A.

Institute of Transport: F. W. Crews, B.A., A.C.I.S.

National Association for Education for Commerce: C. C. E. Brown, F.C.I.S., A.A.C.C.A.

Co-opted Members:

Major-General C. Lloyd, C.B., C.B.E., T.D., B.Sc., F.Inst.P.
A. J. McIntosh, Ph.D.(Econ.), B.Com.
J. Platt, B.Com.
E. M. Rich, C.B.E., F.C.G.I., B.Sc.
W. G. Stone, M.A.

INDUSTRIAL ART BURSARIES BOARD

Sir Ernest Goodale (*Chairman*)
Mrs. Mary Adams, O.B.E., M.Sc.
D. W. Barrett
J. I. Bernard, M.I.E.E.
Sir Alfred Bossom
Cyril Carter
Sir Edward Crowe
Robin Darwin
E. M. O'R. Dickey, C.B.E., Hon. A.R.C.A.
F. H. Dowden, H.M.I.
C. H. Edwards, F.B.S.I., A.M.B.I.M.
R. S. Edwards, Ph.D., B.Sc., A.R.C.S.
E. A. Entwisle
P. A. Le Neve Foster
Miss M. France
John Gloag
Professor R. Y. Goodden, C.B.E., R.D.I., A.R.I.B.A., F.S.I.A.
A. E. Gray
Milner Gray, R.D.I., PP.S.I.A.
The Earl of Halsbury
A. C. Hartley
J. Douglas Hood, J.P., C.B.E.
William Johnstone, O.B.E., D.A.
H. P. Juda, O.B.E., Hon. F.S.I.A.
Lord Latham
James Laver, C.B.E.
Edgar E. Lawley
J. H. Mellor, M.S.I.A.
F. A. Mercer
Oswald P. Milne, F.R.I.B.A., J.P.
Lord Nathan
F. O. R. Plaistow
H. V. Potter, B.Sc., F.R.I.C. M.I.Chem.I., F.P.I.
J. C. Pritchard, O.B.E., M.A.
Ernest Race, R.D.I., P.S.I.A.
A. B. Read, R.D.I., F.S.I.A.
A. R. N. Roberts
Sir Gordon Russell, C.B.E., M.C., R.D.I., Hon.A.R.I.B.A., F.S.I.A.
Professor R. D. Russell
H. V. Shelton
Elkan Simons, F.I.C.D.
L. Dudley Stamp, C.B.E., D.Lit., D.Sc.
G. E. Tonge
J. W. Waterer, R.D.I., F.S.I.A.
Sir Griffith Williams
Miss Anna Zinkeisen, R.O.I., R.D.I.

THOMAS GRAY MEMORIAL TRUST COMMITTEE

Captain L. G. Garbett, C.B.E., R.N. (Ret.) (*Chairman*)
Sir Alfred Bossom
The Honble. G. C. H. Chubb
Dr. J. A. Edgar, H.M.I.
Lord Latham
F. A. Mercer*
Captain G. C. H. Noakes, R.D., R.N.R. (Ret.)
Vice-Admiral Sir Henry Phillips, K.B.E., C.B.
Captain J. H. Quick, O.B.E.
Sir Harold Saunders, F.C.G.I., B.Sc.(Eng.)
G. E. Tonge
Captain H. Topley
Captain G. W. Wakeford, M.B.E.

R.D.I. JOINT COMMITTEE

Appointed by the Council in March, 1958:

Sir Ernest Goodale (*Chairman*)
Mrs. Mary Adams
Sir Alfred Bossom
John Gloag
F. A. Mercer
Dr. L. Dudley Stamp

Appointed by the Faculty of R.D.I.

Professor R. D. Russell
Misha Black, C.B.E., F.S.I.A.
Professor R. Y. Goodden
E. C. Ottaway, M.I.Mech.E.
Sir Gordon Russell

HOUSE COMMITTEE

Sir Alfred Bossom (*Chairman*)
P. A. Le Neve Foster
Sir Ernest Goodale
Dr. R. W. Holland
Edgar E. Lawley
F. A. Mercer*
O. P. Milne
Lord Nathan
E. Munro Runtz
G. E. Tonge*
Miss Anna Zinkeisen

LIBRARY COMMITTEE

Dr. R. W. Holland (*Chairman*)
Sir Alfred Bossom*
Professor Sir Charles Dodds, M.V.O., M.D., F.R.C.P., F.R.S.
P. A. Le Neve Foster*
A. C. Hartley
F. A. Mercer
Lord Nathan
A. R. N. Roberts
G. E. Tonge*
Sir Griffith Williams
J. G. Wilson, C.B.E.

MEMBERSHIP COMMITTEE

O. P. Milne (*Chairman*)
Sir Alfred Bossom*
Sir Frank Brown
P. A. Le Neve Foster
Dr. R. W. Holland
F. A. Mercer*
E. Munro Runtz
Sir Selwyn Selwyn-Clarke
G. E. Tonge

JOURNAL COMMITTEE

P. A. Le Neve Foster (*Chairman*)
Sir Alfred Bossom*
R. E. Dangerfield
Dr. R. W. Holland
F. A. Mercer
Professor R. D. Russell
G. E. Tonge*

TRUST FUNDS BOARD

Sir Ernest Goodale (*Chairman*)
Sir Alfred Bossom*
Edgar E. Lawley
F. A. Mercer*
Lord Nathan
E. Munro Runtz
G. E. Tonge*

SPECIAL ACTIVITIES COMMITTEE

A. R. N. Roberts (*Chairman*)
Mrs. Mary Adams
The Honble. G. C. H. Chubb
Milner Gray
The Earl of Halsbury
A. C. Hartley
F. A. Mercer
Professor R. D. Russell
Sir Harold Saunders
Dr. L. Dudley Stamp
G. E. Tonge
H. A. Warren

REPRESENTATIVES OF THE SOCIETY

The following are the present representatives of the Society upon the Governing Bodies and Committees of other organizations:

City and Guilds of London Institute (Council): Chairman of Council
City and Guilds of London Institute (Art School Committee): to be appointed
City and Guilds of London Institute (Technical Authorship Committee): A. R. N. Roberts
R.I.B.A. Board of Architectural Education: Dr. R. W. Holland
Architects' Registration Council Board of Architectural Education: O. P. Milne
Council for the Preservation of Rural England: A. R. N. Roberts
Chadwick Trust (Trustee): E. M. Rich
London Society (Council): Professor Sir Albert Richardson, K.C.V.O., PP.R.A.
Soane Museum (Trustee): Professor Sir Albert Richardson
Thomas à Becket Cottages, West Tarring (Committee of Management): Oliver Law, F.R.I.B.A.
Henry Edward Armstrong Trustee: E. M. Rich
Science and Industry Committee: Sir Ernest Goodale, A. C. Hartley, A. R. N. Roberts, the Secretary and the Deputy Secretary
Associated Examining Board for the General Certificate of Education: Dr. R. W. Holland and the Examinations Officer
National Book League (National Council): The Master (for the time being) of the Faculty of R.D.I.
L.C.C. Central School of Arts and Crafts (Board of Governors): A. R. N. Roberts
Building Orders Preservation Committee : O.P. Milne
National Advisory Council on Art Education : A. B. Read, R.D.I.

Some Activities of Other Societies and Organizations

MEETINGS

WED. 3 DEC. Analytical Chemistry, Society of, at The Wellcome Building, Euston Road, N.W.1. 3 p.m. Symposium : *Food analysis.*

Central Asian Society, Royal, at Burlington House, Piccadilly, W.1. 1.30 p.m. E. A. V. de Candole : *Development in Kuwait.*

Civil Engineers, Institution of, Great George Street, S.W.1. 5.30 p.m. S. G. Burgess and A. F. Green : *The use of radioactive isotopes for the investigation of sewage treatment plant.*

WED. 10 DEC. Eugenics Society, at Burlington House, Piccadilly, W.1. 5.30 p.m. J. A. Fraser Roberts : *Human genetics at two international conferences.*

Petroleum, Institute of, 61 New Cavendish Street, W.1. 5.30 p.m. Hugh Strawson : *Pumpability of aviation turbine fuels at low temperatures.*

THURS. 4 DEC. Analytical Chemistry, Society for, at Storey Institute, Meeting House Lane, Lancaster. 7.30 p.m. G. F. Reynolds : *Recent advances in polarography and some other electrical methods.*

Illuminating Engineering Society, at Demonstration Theatre, South Wales Electricity Board, The Hayes, Cardiff. 6 p.m. W. Imrie-Smith : *Industrial lighting problems.*

Metals, Institute of, 17 Belgrave Square, S.W.1. 6.30 p.m. E. C. Ellwood : *The continuous casting of bronze.*

FRI. 5 DEC. Works Managers, Institution of, at Royal Society of Arts, John Adam Street, W.C.2. 7 p.m. F. Thorley : *Psychological aspects of work life.*

MON. 8 DEC. Engineers, Junior Institution of, at 44 Union Street, Sheffield. 7.30 p.m. Film : *Hydraulic systems and multigrade oils.*

Kinematograph Society, British, at Film House, Wardour Street, W.1. 7.30 p.m. H. E. Whitney : *Heating and ventilation equipment.*

Purchasing Officers' Association, at Royal Society of Arts, John Adam Street, W.C.2. 7.30 p.m. J. R. Blinch : *Purchasing Officers' Association—what of the future?*

Transport, Institution of, at 66 Portland Place, W.1. 5.45 p.m. E. R. L. Fitzpayne : *The history of wage negotiations in the municipal transport industry.*

TUES. 9 DEC. Architects, Royal Institute of British, 66 Portland Place, W.1. 6 p.m. P. E. A. Johnson-Marshall : *Comprehensive redevelopment.*

WED. 10 DEC. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. A. H. Mumford : *Bridging the Atlantic.*

Engineering Inspection, Institution of, at Royal Society of Arts, John Adam Street, W.C.2. 6.45 p.m. J. McAfee : *A1 at Lloyds.*

Locomotive Engineers, Institution of, at Institution of Mechanical Engineers, 1 Birdcage Walk, S.W.1. 5.30 p.m. J. S. Scott and J. K. Lord : *Maintenance and overhaul of electric locomotives and multiple-unit sets of the Manchester-Sheffield-Wath electrification.*

THURS. 11 DEC. Chemical Society, at Burlington House, Piccadilly, W.1. 7.30 p.m. Professor G. Porter : *The triplet state in chemistry.*

Mechanical Engineers, Institution of, at 2 Savoy Place, W.C.2. 5.30 p.m. C. M. Cock : *The 'Deltic' locomotive.*

Public Health Engineers, Institution of, at Caxton Hall, Westminster, S.W.1. 6 p.m. P. Sutcliffe : *The impact of public health engineering on ecology.*

FRI. 12 DEC. Royal Institution, 21 Albemarle Street, W.1. 9 p.m. T. E. Allibone : *The fusion of heavy hydrogen*

MON. 15 DEC. Geographical Society, Royal, 1 Kensington Gore, S.W.7. 8.30 p.m. Colonel G. R. Laclavere : *Antarctica and the I.G.Y.*

Kinematograph Society, British, at I.C.I. Ltd. Theatre, Imperial Chemical House, Millbank, S.W.1. 8 p.m. Kenneth G. Gray : *Colour.*

WED. 17 DEC. Analytical Chemistry, Society for, at The University, Edmund Street, Birmingham 3. 6.30 p.m. Discussion : *Flame photometry*

Newcomen Society, at The Science Museum, Exhibition Road, S.W.7. 5.30 p.m. P. N. Wilson : *Early water turbines in the United Kingdom.*

Radio Engineers, British Institution of, at London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. 6.30 p.m. I. J. P. James : *A vidicon camera for industrial colour television.*

THURS. 18 DEC. Road Transport Engineers, Institute of, at Royal Society of Arts, John Adam Street, W.C.2. 6.30 p.m. J. F. Moon : *Transport development in the U.S.A.*

William Morris Society, at 17 Fleet Street, E.C.4. 6.30 p.m. John Swannell : *William Morris and Old Norse literature.*

FRI. 19 DEC. Mechanical Engineers, Institution of, 1 Birdcage Walk, S.W.1. 6 p.m. M. P. Danel : *The hydraulic turbine in evolution.*

OTHER ACTIVITIES

NOW UNTIL 8 DEC. Arts Council Gallery, Cambridge. Exhibition : *Sculpture in the home.*

NOW UNTIL 14 DEC. Tate Gallery, Millbank, S.W.1. Wed., Fri., Sat. 10–6 p.m. ; Tues, Thurs. 10–8 p.m. ; Sun. 2–6 p.m. Admission 1s 6d. An Arts Council Exhibition of *Modern Painting: from the Urvater Collection.*

NOW UNTIL WED. 31 DEC. Hanover Gallery, 32a St. George Street ,W.1. Exhibition of *sculpture by Paolozzi.*